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☞ An asterisk (*) denotes an illustrated article

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WISHING TO MAKE THIS JOURNAL an organ of intelligent discussion to those of our readers who may wish to gain or give information on the subjects to which its columns are devoted, the publishers solicit letters from all among them who make the study of these subjects a pleasure, or a profession.

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FIFTH ANNUAL MEETING OF THE AMER. GAS LIGHT ASSOCIATION.

The fifth annual meetinng of the Association will be held at Cincinnati, O., on Wednesday, Oct. 17, 1877. Headquarters will be at the Gibson House on Walnut St. between 4th & 5th where arrangements have been made for the members at special reduced rates per day.

The meetings will be held in Gas Hall, corner of 4th and Plum Sts. Members are requested to prepare papers on any subject connected with ga matters, and to confer with the Secretary concerning the same. CHAS. NETTLETON, Sec'y., 117 Broadway, New York.

NAPHTHALINE.

The subject of naphthaline in illuminating gas, has recently been the subject of careful investigation by some of the leading Gas Engineers in France. Mr. Lucien Bremond the engineer of the Versailles Gas Works has submitted to the *Society Technique de l' industrie du Gaz en France* an account of investigations which he has been making on this subject. We shall take great pleasure in a future number in giving a translation of the paper in full, but it seems to us that for the first time, Mr. Bremond has taken up this matter in a thoroughly systematic and scientific manner. Not satisfied with simply considering the fact that wherever retorts are run at high heats the result is a nuisance from Naphthaline, he has gone into the matter to find why such is the case, and it would seem that his solution of the cause would lead to some very important results. It appears from experiments made both on a small and a large scale, that the deposition of naphthaline is caused by the condensation of aqueous vapor contained in the gas, and that when the gas is deprived of aqueous vapor by a drying process, such as passing it through quick lime or chloride of calcium, no deposit of naphthaline was found. He also shows how naphthaline may be produced, under favorable circumstances of temperature, from benzine and styroline, benzine and acetyline, styroline and ethyline, etc.

The *Journal des Usines a Gaz*, of September 5th, contains an article by Mr. Bremond upon this subject, and we give our readers a few extracts.

"Naphthaline contained in illuminating gas, either in suspension or in solution in other vapors of gas, is one of the hydrocarbons richest in carbon. Its formula is C_{10} H_8. It obstructs the pipes of works, and from this obstruction an increase of pressure results which the gas is obliged to overcome; from the dimunition of the delivery and the increase of force required of the exhausters there follows an increase in amount of fuel used. In the pipes of the city, obstructions of services, either in house services or lamp posts, cause complaints and vexation.

"Naphthaline is produced in the retort and I explain this production by the *igneous* reactions so well studied by the learned chemist M. Berthelot. Beyond this production in the retort I believe that naphthaline may be formed under other circumstances and I refer the reader wishing to know my second hypothesis to the memoir which I have submitted to the Society Technique. From experiments I have made I am able to assert that naphthaline, both when held in solution in other vapor or gas, and when formed otherwise becomes solid when the vapor of water contained in the gas is set free from it. This vapor of water can separate from the gas either by condensation, or, if arrested by a chemical process, by dishydrasation. But the napnthaline furnished at the moment when the vapor of water is condensed cannot stop at the same point where the water of condensation falls. Its density being very light compared with that of water, the crystals or the flakes of naphthaline are carried forward by the current of gas, and are only deposited at a point where, by a change of velocity, an eddy is formed. It is deposited also when it encounters a material obstacle. There are so many different points where naphthaline is met with and so many different times that those who have studied the subject have been perplexed. However, it is not more uncertain in its causes and effects than any other. * * *

"In a series of laboratory experiments I have dried the gas with chloride of calcium, then I have upon a large scale, using more than 4,000 cubic metres of gas, dried it with quick lime. This desiccation took place before the perfect purification of the gas. There was no naphthaline. The pipes were as clear as the day they were placed, all through the course of the desiccated gas. On the contrary the pipes in which the gas passed in its ordinary state, and in comparative experiments, were entirely closed. The conditions of the experiments were the same.

"These are the indisputable facts and results to-day, acquired by these experiments which have lasted entire months, and have been repeated several times.

"I believe they will serve as a basis for an entire modification in the manufacture of gas, and that we shall no longer know the inconveniences of naphthaline. It is also well to state other consequences of this proceeding."

The above results are certainly very interesting and we trust that still further investigation may lead to the removal of this *bete noir* of the gas maker.

Action of the Directors of the Peoples Gas Light Co. of Brooklyn, upon tne death of Mr. John Halsey.

At a meeting of the Board of Directors of The Peoples Gas Light Co. held this day, the following preamble and resolutions were ananimously adopted :

Whereas, It has pleased an All-Wise Providence, to call from this life our esteemed friend and respected associate Mr. John Halsey, who, for years has occupied the position of Director and Treasurer of this company, therefore be it

Resolved, That the Directors of The Peoples Gas Light Co. learn with sincere regret of the death of Mr. John Halsey, a man full of years, and one who will always be remembered as a faithful friend and adviser.

Resolved, That his life of more than three score years and ten, has always been such as to command respect and stimulate emulation, and the loss of his usefulness as a good and benevolent citizen is almost irreparable

Resolved, That we deeply sympathize with the relatives in the loss of so eminent a member of of the community; and as a mark of respect the members of Board will attend the funeral in a body, and that the foregoing resolutions be spread upon their minutes, and published in the Brooklyn papers.

Brooklyn, Sept. 24th, 1877:

ILLNESS OF MR. SAMUEL P. PARHAM.

We regret to hear of the serious illness of Mr. Samuel P. Parham, who was attacked with a severe stroke of paralysis a short time since. This is undoubtedly the result of a long continued and ceaseless application of all his energies, both physical and mental, to the promotion of the large interests committed to his care as Engineer of the New York Mutual Gas Light Company. In the application andadaptation of apparatus for the manufacture of illuminating gas from petroleum and its products, Mr. Parham has made many experiments on a very large scale, and it is to be regretted that, in the prime of life. he should be thus stricken down, and the profession deprived of the services of so careful, thorough, and successful an engineeer. We understand that his place is to be occupied by Mr. Prosser, of Brooklyn.

In retiring, as we hope, only for a season from the active practice of his profession, Mr. Parham, will have the sympathy and best wishes of all the many friends he has made during the many years he has been connected with the manufacture of illuminating gas in this city.

Method of Purifying the Residuum of Gas Works before Allowing It to Pass Off into the Water.

By J. R. Shotwell.

[Through the politeness of Prof. Spencer F. Baird, of the Smithsonian Institution, we have received advance sheets of an article prepared at his request, by the President of the Rahway Gas Light Company for publication in his forthcoming report on the Fish and Fisheries of the United States.

The subject is one that should receive the attention of Gas Light Companies, as well as of persons interested in the preservation of our food fishes.—Ed.]

Rahway, N. J., May 29, 1877.

My Dear Sir : At our recent meeting in New York you requested me to write you a description of the process by which the Rahway Gas-Light Company eliminates the offensive and injurious portions of the residual products resulting from the distillation of coal, in the manufacture of gas, before allowing them to pass off into the river. Our works are on the margin of a small stream, a branch of the Rahway River, whose banks, for nearly a mile below the works, are occupied by residences, and several streets cross it by bridges. To avoid the annoyance to the community caused by the overflow from the tar-wells, we built supplemental wells to receive and hold the ammonia water and light oils that constitute the overflow. Valves with long rods reaching above the surface were placed at the bottoms of these wells, and the men in charge of these works were directed to open the valves after midnight so that the offensive products might be carried off by the current before morning. This plan did pretty well while the works were very small, but as the quantity of gas made increased, the refuse necessarily increased also, and complaints multiplied against our defilement of the waters.

About two years since we adopted a plan, at the suggestion of Mr. Geo. W. Edge, of the Jersey City Gas-Light Company, of straining the overflow through a mass of the finer particles of coke, technically called "breeze," before allowing it to pass into the river. This has proved completely successful.

The accompanying drawings and descriptions will show the simple and inexpensive method of accomplishing the very important result of removing the deleterious matter from the ammonia water before it is allowed to flow into the river. We have one tar-well at the retort-house and another at the purifying house, each one having its supplemental well. These wells have been adapted to the new process I have described by merely dividing them in a horizontal partition, as shown in the drawings. It will readily occur to any engineer of gas works that the same process could be carried out in various ways.

One remarkable feature in our experience in this matter is that we have never changed the breeze since it was first put in. We pump out the "dead oil" that accumulates at the bottom of the upper section of the well about once a month, and that is all the care we give it. The valves at the bottoms of the wells are now left open, and the ammonia-water, freed from the "dead oil," light tar, and all insoluble matter, is allowed to flow into the river as fast as it is made.

It is evidently soon diffused, and produces no bad effects upon the fishes that constantly sport in the water, near the outlets of the wells, nor is it noticed by the dwellers on the banks of the streams.

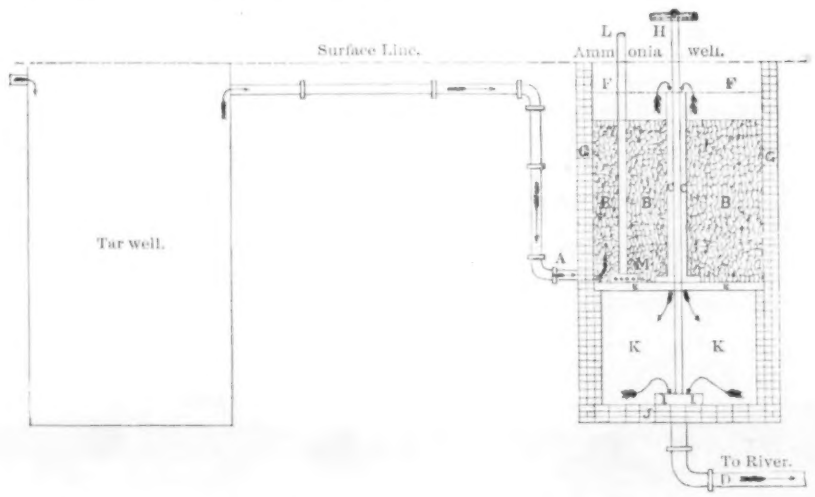
If my explanations and drawings do not make the case clear to you, I shall be glad to endeavor to elucidate any obscure parts, and to show you, or any one interested, the actual working of this simple but very efficient device.

I am, very respectfully and truly, your friend,

J. R. Shotwell,

Prof. Spencer F. Baird,

United States Commissioner of Fish and Fisheries, Washington, D. C.



A is the inlet well. B is the space filled with coke and breeze through which the ammoniacal liquor passes upward, leaving the insoluble matter in the interstices of the coke. The water containing ammonia and other soluble salts passes to the top F, and descending down pipe C to chamber K, and then out through valve I and pipe D to river. The wall G is two bricks thick from the top to E. From E to J it is three bricks thick, to form a ledge for bottom, E. J is the bottom of the well, three bricks thick. E, the bottom of the upper section B, is made of two inch plank, covered with two inches of cement. F is the over-flow line. C is the overflow pipe, with flange at bottom bolted to E, and covered with cement to make it water-tight. H is the iron rod with wheel at the top to turn valve I. I is the valve and box, laid in cement, over discharge-pipe D. K is the the lower section of the well which receives the ammoniacal liquor before it is discharged out of pipe D. L is the pipe through which the tar and oil are pumped from the bottom of section B. M is the chamber or box perforated with small holes at the bottom of section B to collect the tar and oil from the breeze so that it may reach the pump-pipe L.

Cantor Lectures.
The Chemistry of Gas Manufacture.

By A. Vernon Harcourt, Esq., M.A., F.R.S.
Lee's Reader in Chemistry at Christ Church, Oxford, and one of the Metropolitan Gas Referees

[From the London Journal of the Society of Arts.

Lecture III.—Monday, March 19.

Really, the question resolves itself into a commercial question, as to what is the value of the

impression which exists on this subject. Now, if it were possible that gas could be supplied otherwise than as a monopoly, and that consumers of gas could have the choice, which they would have—gas which cost rather less, say 3s. 9d. per 1,000 cubic feet, and which contained some 35 grains of sulphur in 100 cubic feet, or gas which cost rather more, say 3s. 11d., and which contained less sulphur, say 10 or 12 grains in 100 cubic feet—which would be preferred? I do not know what the general feeling is, but, for myself, considering both the sensible effect on the atmosphere of a room, and the likelihood of injury to articles of furniture from even a slight vitriolic dew, such as undoubttdly is deposited, I would rather pay the extra twopence and have the purer gas.

I pass now to the modes by which the carbon bisulphide in gas, supposing its removal desirable, can be removed. The process generally employed for its removal is the transmission of the gas through lime which has already served for removing sulphuretted hydrogen; and, as far as the immediate object is concerned, it is not possible to have a better agent. If coal gas, or hydrogen which has been charged with bisulphide of carbon, passes through a not excessive quantity of sulphide of calcium—the substance into which the lime is changed by the action of sulphuretted hydrogen—the bisulphide of carbon is wholly removed. I believe this removal can be effected almost as completely by the action of sulphide of calcium as that of carbonic acid, or sulphuretted hydrogen, by the agency of clean lime.

I have here a little apparatus which I contrived a year or two ago for the estimation of sulphur in coal gas. It consists of a small bulb, which is filled with pieces of pumice which have been steeped in solution of platinum, the object being to have in a small space a large surface. Through this bulb the gas passes; it is surrounded with a cylinder of porous clay, and there is a lamp burning with a very small flame beneath it. The gas enters by the tube, passes down to the bottom of the bulb, and then up through the heated material, and so out by the horizontal tube. Thence it passes downwards through a capillary tube into the liquid in this glass. The liquid is a solution of lead in soda, mixed with some syrup or solution of sugar. The lead serves to give a dark color with the sulphuretted hydrogen, which passes into the solution. The gas, as it enters the apparatus, is free from sulphuretted hydrogen, but the action of the heated surfaces upon it transforms the bisulphide of carbon which it contains, in presence of the hydrogen of the gas, into sulphuretted hydrogen. Thus, the test consists of two parts. First, there is the action of the heated surfaces on the gas, which turns the bisulphide of carbon into sulphuretted hydrogen; and, secondly, there is a test for sulphuretted hydrogen—namely, the lead solution which is colored by it. In order to make a quantitative estimation, I have by the side of the lead solution another glass, containing a liquid of a color similar to that which the lead solution will acquire. The solution is not the same, for the solution which is colored with sulphide of lead is not colored permanently; by this light it is permanent, but exposed to daylight it quickly fades. All that is necessary is to have a solution, whose color is fixed, comparable with that of the liquid colored by the sulphide of lead. It is also necessary to know what quantity of gas is operated upon. That is ascertained by running the water from the aspirator, which draws the gas through, into this graduated cylinder. Then, on reading off the quantity of water, I know that from a volume of gas, which is equal to this volume of water, has been extracted a quantity of sulphur sufficient, in the form of sulphide of lead, to impart this degree of brownness to this volume of lead solution. Such a comparison constitutes a quantitative test and by the action of the heating apparatus it is applicable not only to gas containing sulphuretted hydrogen, but also to gas which contains bisulphide of carbon, for the estimation of the quantity of sulphur present in that form.

Besides calcium sulphide many other substances have been tried for the purification of gas from bisulphide of carbon. It would be very desirable, if it were possible, to use a liquid instead of a solid reagent for this purpose, because it would be much easier, in working with a liquid, to avoid that nuisance which is liable to arise, unless special precautions are taken during the removal of this sulphide of calcium, or, as it is justly called, "foul lime." I have made many experiments on this subject, and the results of a few I have made recently are written upon the board. I have tried with an apparatus which I showed you in my last lecture, and which is an efficient form of washer for laboratory experiments, the action of various liquids upon the coal gas supplied at Oxford. Here are some of my results. I made an examination, first, of the gas supplied to my laboratory, and found it to contain 33 and 1-2 grains of sulphur in 100 cubic feet. Then I passed the gas, at the slow rate at which it travels through the testing apparatus, over a solution of ammonia sulphide—which is one of the liquids that have been recommended—but I found that the amount of sulphur remained practically unaltered. Then I passed the gas over ammonium sulphide in which an extra dose of sulphur had been dissolved—the liquid dissolves sulphur readily, and acquires a bright yellow color. Again I found that, practically, the sulphur was unaffected. Then I tried a solution which suggested itself to me as being likely to succeed—a mixture of ammonium sulphide, with calcium chloride. When these substances are mixed the lime is not precipitated, but remains in solution. We have, therefore, a solution probably containing ammonium chloride and calcium sulphide, and I thought this might answer as well as the solid calcium sulphide. I have written up the actual numerical results obtained in the different experiments, but they are practically the same. There was no improvement produced by washing the gas with that reagent. Then I tried another substance which has been recommended a solution of sodium sulphide. It has been assumed that this solution would answer as well as the solid calcium sulphide itself. But again I found that no effect was produced. I tried a solution of litharge in caustic alkali, and that also had no effect.

The only liquid which produced any improvement in the gas was some of the less volatile part of the petroleum. It seemed likely that the reason why the other substances had no effect was that they were all dissolved in water. Bisulphide of carbon does not mix with water, and, consequently, substances which are in aqueous solution are as if they were varnished over and kept from contact with the carbon bisulphide. If we take a liquid which can be mixed with carbon bisulphide, such as alcohol—an alcoholic solution of potash, for instance—then we have an action. I found that the heavy petroleum mixes readily with carbon bisulphide; and I found, using that as a washing liquid, that there was by no means a complete effect, but still a considerable effect, that the quantity of sulphur in the gas was reduced to something like one-half what it had been previously.

Another mode of removing carbon bisulphide from gas, which has suggested itself to various persons—I believe the first who brought it prominently forward was Mr. Bowditch, a good many years ago—is by acting upon the gas with heated surfaces. I use that expression rather than heating the gas; because I believe if it were possible to heat the gas without placing it in contact with heated surfaces, the effect would be little or none. When gas is brought into contact with heated surfaces—it is not necessary that their temperature should be even near that of a red heat—the change which I have already referred to, in explaining the principle of the color test, takes place, and the hydrogen of the gas and the carbon bisulphide act upon one another, and sulphuretted hydrogen is formed. This, therefore, if we use it on a large scale, offers the means of removing the sulphur from its combination with carbon—in which form we have no more convenient reagent than calcium sulphide for arresting it—into a combination with hydrogen, which we are able to remove by means of oxide of iron.

The experiment of acting upon gas with heated surfaces was tried on a rather large scale, between two and three years ago, at the Horseferry-road Station of the Gaslight and Coke Company. I have here a diagram showing two sections of an apparatus constructed by Dr. Siemens for this experiment.

The apparatus was in action for some time, but as will happen with experimental apparatus, there were many difficulties in working it. The iron plates which separated the gas from the fire cracked, and were difficult to mend. The gas which escaped ignited, and added to the strength of the fire, and the temperature was liable to become unduly high. Also the material through which the gas passed was in too large pieces, and did not present a sufficient surface.

I have here a record of my experiments, showing that two or three times, for a week or ten days together, when passing gas through the apparatus at the rate of 10,000, or even 20,00 cubic feet an hour, I succeeded in reducing the amount of sulphur from 30 or 40 grains to between 10 and 15 grains per 100 cubic feet of gas. But, after these short periods of successful working, the purifying effect gradually diminished.

I think that probably this disappointing result arose from the difficulty of managing the temperature of the apparatus, and the ill effect of heating it too strongly—viz., a deposition of carbon upon the materials with which it was filled. The amount of this deposition of carbon was not such as to produce any prejudicial effect on the illuminating power of the gas, but it affected the surface of the material which was used to act upon the gas, and rendered it much less efficient for the purpose.

I have made, since that experiment was terminated, a good many more laboratory experiments on the same subject, especially to ascertain what material was most favorable for the purpose, and I find that the quantity of the substance which it is necessary to heat, and also the requisite temperature, may be very much reduced by having a different material, and that in a form more favorable to the action of its surface and the equable distribution of the gas current. I have made recently a number of experiments with a material made into what appears to be the most desirable form—viz., little balls, and consisting of a mixture of clay and oxide of iron, the latter of which is changed, when thus heated in the presence of coal gas, into metallic iron. The particles of iron which are formed, being separated by being mixed with clay, do not fuse and run together, as

iron which is heated in gas containing sulphur is apt to do if particles are contiguous one to another, but are kept apart in a state of fine division, and thus present a large surface. The quantity of gas that can be purified by a very small amount of this material is really very remarkable. I have made quantitative experiments using only the amount of material which I have in such a bulb as this, containing about 2 cubic inches, or somewhat less. I have passed the gas through this bulb, heating it in the manner shown, measuring the rate at which it passes, collecting it, and then ascertaining how far the sulphur in the gas was reduced.

I tried, first, whether making these balls of clay only would answer the purpose, and I found that for a moderate rate of passage of the gas, clay answered fairly well; but when I forced a larger quantity of gas through the small bulb the effect diminished. I then tried the mixture I have described, of clay and iron, and with this I found that I could purify gas as fast as, with the pressure at my command, I could send it through the bulb. On sending the gas through at the rate of between 9 and 10 cubic feet an hour, which, considering the quantity of material used, is very fast indeed, the purification effected is as great, with that rapidity of passage, as it is with a lower rate.

After streaming through the contents of the bulb, the gas was purified from the sulphuretted hydrogen which is formed, by passing it through a small tube containing oxide of iron. When balls of clay were used, and a small quantity of gas passed through, the amount of sulphur remaining was only 9 or 10 grains; but when a larger quantity was sent through—namely, 6, 7, 9, cubic feet per hour—then gradually the effect diminished and almost disappeared. But with balls of clay and iron, even with this large quantity of gas passing through, the effect was always uniform, and the amount of sulphur, which, as it entered the apparatus, was between 30 and 33 grains per 100 cubic feet, was uniformly reduced in all my experiments to between 9 and ten grains per 100 cubic feet.

I have, of course, been alive to the danger of this effect being a transient one. Some weeks of continuous heating and passage of gas have not impaired it, and I am now engaged in pushing the trial further. I hope to find that the lower temperature which, with this material, is sufficient for the destruction of carbon bisulphide, may be low enough to cause no deposition of carbon from the gas. Experiments on a large scale are difficult to make; but my belief is that, if I could place in the top of the large experimental apparatus such a material as I now use, it would purify a much larger volume of gas than was actually through it. It is easy to calculate, from the experiment on a small scale, what should be the effect of using the same material on a larger scale—that is, how much gas should be purified, if, instead of employing these two cubic inches, I employed, say, a cubic yard. I find, making this calculation, that to purify the winter make of gas of some of the largest London gas-works, such as 5½ million cubic feet a day, it would only be necessary to use one cubic yard of such material—that is to say, a quantity which could most easily have been placed in the top of the apparatus that I had in use.

[To be continued.]

Disastrous Fire.—On Friday night the 21st Sept. a disastrous fire occurred at Keyport, Monmouth Co., N. J. which swept almost the entire business portion of the place, inflicting a loss of nearly $200,000, only a little over a third of which was insured. It is supposed that the fire originated in a butcher's shop by the explosion of a kerosene lamp.

Official Report of Examinations of Illuminating Gas, for two weeks ending August 4 1877, made at the Photometrical Room of the Department of Public Works.

Date.	Time.	Temperature of Thermometer.	Gas Company	Burner.	Pressure at Point of Ignition.	Consumption of Gas. Rate per hour.	Consumption ofCandle, Grs. per hour	Illuminating Power.	
								Observed.	Corrected.
1877.		Deg.			In.				
July 23	12 M.	82	Manhattan.....	(Argand "Standard,") (Sugg-Letheby 15 holes')	.06	5.01	123.00	16.82	17.20
" 23	3.30 P. M.	83	New York....	(Argand "Standard,") (Sugg-Letheby, 15 holes)	.05	5.01	123.75	16.20	16.66
" 23	4.30 P. M.	84	N. Y. Mutual.....	(Argand "Standard,") (Sugg-Letneby, 15 holes)	.05	4.25	122.25	16.12	19.31
" 24	5.30 P. M.	84	Manhattan	(Argand "Standard,") (Sugg-Letheby, 15 holes)	.06	5.04	120.00	18.48	18.33
" 24	7 P. M.	84	New York.....	(Argand "Standard,") (Sugg-Letheby, 15 holes)	.05	5.02	123.00	16.24	16.58
" 24	2 P. M.	83	N. Y. Mutual.....	(Argand "Standard,") (Sugg-Letheby, 15 holes)	.05	4.25	124.50	15.78	19.25
" 25	12 M.	84	Manhattan	(Argand "Standard,") (Sugg Letheby, 15 holes)	.05	5.00	123.00	17.00	17.42
" 25	9 A M.	83	New York.....	(Argand "Standard,") (Sugg-Letheby, 15 holes)	.05	4.97	121.50	16.32	16.61
" 25	11 A. M.	84	N. Y. Mutual.....	(Argand "Standard,") (Sugg Letheby, 15 holes)	.06	4.12	124.50	15.40	19.38
" 26	1 P. M.	86	Manhattan	(Argand "Standard,") (Sugg.Letheby 15 holes)	.05	5.05	124.20	17.12	17.53
" 26	12 M.	85	New York.....	(Argand "Standard,") (Sugg-Letheby, 15 holes)	.05	4.98	120.60	16.72	16.87
" 26	2 P. M.	86	N. Y. Mutual.....	(Argand "Standard,") (Sugg-Letheby, 15 holes)	.04	4.22	120.00	17.20	20.38
" 27	11 A. M.	88	Manhattan	(Argand "Standard,") (Sugg-Letheby, 15 holes)	.04	4.96	121.20	17.96	18.28
" 27	10 A. M.	87.5	New York	(Argand "Standard,") (Sugg-Letheby, 15 holes)	.05	5.06	124.20	16.72	17.08
" 27	9 A. M.	87	N. Y. Mutual.....	(Argand "Standard,") (Sugg-Letheby, 15 holes)	.05	4.16	119.40	17.32	20.71
" 28	9 A. M.	84	Manhattan	(Argand "Standard,") (Sugg-Letheby, 15 holes)	.05	4.98	124.20	17.20	17.87
" 28	9.20 A. M.	84	New York....	(Argand "Standard,") (Sugg-Letheby, 17 holes)	.04	5.00	123.00	16.04	16 44
" 28	10 A. M.	84.5	N. Y. Mutual.....	(Argand "Standard,") (Sugg-Letheby. 15 holes)	.05	4.36	121.20	16.88	19.54

Date.	Time.	Temperature of Thermometer.	Gas Company.	Burner.	Pressure at Point of Ignition	Consumption of Gas. Rate per hour.	Consumption of Candle, Grs. per hour.	Illuminating Power.	
								Observed.	Corrected.
1877.		Deg.			In.				
July 30	1 P. M.	85	Manhattan.....	Sugg-Letheby, 15 holes...	.04	5.01	121.05	17.72	17.89
" 30	11 A. M.	85	New York.	" "	.04	4.94	123.00	15.28	15.84
" 30	9 A. M.	83.5	N. Y. Mutual.....	" "	.05	4.18	118.05	17.84	21.06
" 31	11 A. M.	83.5	Manhattan.....	" "	.04	5.00	120.00	18.20	18.20
" 31	12 M.	83.5	New York.....	" "	.05	4.98	123.00	15.76	16.21
" 31	1 P. M.	84	N. Y, Mutual.....	" "	.05	4.34	124.05	16.60	19.83
Aug. 1	12 M.	83	Manhattan.....	" "	.04	5.10	125.25	17.44	17.84
" 1	11 A. M.	82.5	New York.....	" "	.04	5.00	120.00	15.88	15.88
" 1	10 A. M.	82	N, Y. Mutual.....	" "	.04	4.34	126.00	16.24	19.63
" 2	10 A. M.	80	Manhattan.....	" "	.03	4.98	123.00	17.68	18.19
" 2	9 A. M.	80	New York.....	" "	.03	5.01	124.05	15.96	16.51
" 2	11 A. M.	80	N. Y. Mutual.....	" "	.03	4.58	124.05	16.97	19.22
" 3	10 A. M.	79.5	Manhattan.....	" "	.03	4.97	126.00	14.36	17.27
" 3	9.30 A.M.	79	New York.....—	" "	.03	5.06	117.00	17.04	16.41
" 3	9 A. M.	78	N. Y. Mutual.....	" "	.04	4.54	121.05	17.64	19.66
" 4	9.30 A.M.	80	Manhattan.....	" "	.03	4.95	117.75	18.36	18.19
" 4	10 A. M.	80	New York.....	" "	.03	5.06	118.05	17.48	17.05
" 4	11 A. M.	80.5	N. Y. Mutual.....	" "	.03	4.00	117.75	18.04	22.11

E. G. LOVE, Gas Examiner.

British Association of Gas Managers.

WEDNESDAY JUNE 13

Continued from page 117.

Mr. JOHN REID (Edinburgh) read the following paper on

A MECHANICAL DIFFICULTY WITH COAL TAR, AND METHOD OF SURMOUNTING IT.

Early last year my company leased the tar and liquids produced at their works for a period of years to Mr. Ross, manufacturing chemist, Falkirk, and undertook to pump the tar from the tar-well in their works into a cistern overhead, elevated 45 feet above the ground; and the lessee undertook to accept delivery from the said cistern, and remove it daily by railway tank-wagons.

As no convenient loading-bank could be had near the works, accomodation was obtained on the Portobello branch of the North British Railway Company at fully one quarter of a mile eastward from the gas-works, where cisterns containing 50,000 gallons are erected on a platform high enough to allow their contents to flow into the wagons when brought alongside.

The pump-cistern at the gas-works communicates with the storing cisterns by means of a 6-inch pipe, having its discharing end lower by 15 feet than the feeding end at the gas-works, and giving a head pressure of 15 feet at the delivery end into the storing cisterns. But in consequence of intervening obstacles the conecting pipe, instead of having a uniform declination from the one cistern to the other, had to be laid in the manner of an inverted syphon, of which 1200 feet of its length is embedded in the earth 4 to 5 feet deep under the railway, turning upwards, by vertical pipes at each end, to the feeding and receiving cistern respectively.

Having some apprehension from the first that trouble would arise in the event of a temporary stoppage of the stream in the pipe, whereby the confined tar might cool and lose fluidity, as tar from cannel coals will do from cold, only a few weeks elapsed until this really occurred. The engine-pump having stopped for a few hours for repairs, it was found that the head pressure of 15 feet was quite ineffectual in restoring the discharge at the distant end, and several hours were employed in expedients before it could be again induced to move on. Of course, the best preventive of a recurrence of this interruption in future was to have a supplementary pump to work by hand, and keep the current in motion. This was at once provided, and has been once or twice in requisition, and serves the purpose efficiently.

But in the course of the autumn it was observed that repeated daily interruptions in the flow occurred, continuing for longer or shorter periods, and occasioned by the circumstance that the same tar pump is employed all the year through; and while it is large enough in capacity to pump more than is produced in the middle of winter, it is larger by three or four times than is necessary in the summer months. And it so happened that several times daily the flow of tar suddenly stopped from the well becoming empty, and the large mouth of the suction-pipe becoming unsealed, and the tail pipe filled with air.

When this ocrurred, and owing to the great surface area of the tar-well, sometimes more than an hour elapsed before the pump got disentangled from the volume of air filling the tail-pipe, and began again to lift the tar.

Feeling that even half an hour's stagnation might in cold weather lead to the greatest inconvenience and danger, and the speed of the engine driving the pump had to be kept up for other important purposes, the evil could not be met in that way And it was obvious that the perfect remedy lay in devising, if possible, some method whereby the quantity of tar raised by the pump should be made to coincide exactly with the quantity and rate at which the tar is deposited in the well.

Thinking this matter worth explaining to the Association, I shall now describe the very simple but effective contrivance I have found to solve the difficulty.

Every engineer knows what happens to any pumping apparatus if a hole should break out in the suction or tail-pipe. In the proportion that any such hole admits air into the tail-pipe by each stroke of the pump in that proportion is the volume of liquid raised by each stroke diminished.

Taking advantage of this fact, I provided an artificial air-hole to the tail-pipe of the tar-pump. This air-hole possessing the self-acting property of adjusting the size of the orifice, so as to admit the precise quantity of air that will compel the pump, at whatever speed, to continue pumping and maintaining the flow unbroken, and at the same time constrain it to draw the tar only *as fast as*, but *no faster than* it runs into the well.

The level of the tar in the well having been fixed at about one-third of its contents, never varies in depth, more than from 1 to 2 inches. The float and stem rising or failing with the slight changes in the tar level, correspondingly opens or closes by means of a small lever, the orifice of the air-cock, and thereby regulates the volume of air admitted by it into the tail-pipe. The air-cock contrivance, while never allowing the pump to lose its *fang*, has in every way the whip hand of the pump, which it never allows to draw more nor less per stroke than the volume of tar that is for the time being deposited in the well. This it has continued to do uninterruptedly day and night during the last nine months, and has required no looking after whatever.

I may just mention that, after devising and applying this method, I thought I had solved the difficulty by a rather roundabout way. Would it not have answered the same purpose to have made a slit in the suction-pipe, to admit the necessary air without any float to open the stopcock? That would have the same effect, but it does not fulfil the whole duty performed by this arrangement. This cock may be put out of action at any time, and leave the pump entirely dry.

Mr. Hislop (Paisley): I am sure we are all very much indebted to our friend, Mr. Reid, for having brought this matter before the Association. I think the arrangement he has shown is certainly a good one. Had the air opening been made in the descending pipe it would have left a portion of the thick tar always in the bottom of the well, while by this arrangement he is able to draw from the bottom pipe, and the denser portions of the tar may be pumped. It is altogether a very simple arrangement, and seems to me to answer the purpose most efficiently.

Mr. Hall (St. Andrew's); I suppose it was the air accumulating in the empty pipe that caused the stoppage?

Mr. Reid: Yes.

Mr. Hall: I have no experience in that subject with tar, but I know a similar difficulty occurs with water in like circumstances. When the pipes supplying mansions are not attended to, the air gets into them and stops the flow of water, and the way to get rid of this is to erect a standpipe at the highest point, which allows the air to escape.

Mr. Reid; The object aimed at was to maintain in the long pipe, which lay in the ground, a constant flow or current—not to allow that current to be suspended for even half an hour. This pump takes up the tar just as it is made, and I believe since it was put on, in the beginning of October, the stream at the delivery end has not been seen to stop for a single instant. It keeps the pipe constantly warm, so that the tar cannot get cool and solidify.

Mr. Peebles (Edinburgh)—I think this is a most admirable arrangement, and is exactly fitted for its purpose. It goes away down in the form of a syphon, and maintains an action in the level pipe exactly the same as if it were a pipe on a small incline. The tar is taken away in very small quantities, instead of accumulating in the well, and there is a continual flow of tar at the minimum rate. I have great pleasure in saying that this is an admirable arrangement to obviate the stoppage of the flow of tar.

Mr. Smith (Aberdeen)—The same object would be gained by returning the tar through the delivery-pipe when the float fell a certain distance to open the stop-cock.

The President—You would not have a constant flow by that means.

Mr. Reid—The object is to convey along the pipe a constant stream of heat, and keep the tar in a liquid state.

Mr. Smith—When the pump was throwing a certain quantity, if the float fell in the well, thereby opening the stop-cock, the tar would be returned back into the suction-pipe.

The President—There is an upright pipe at each end, and a level pipe between, and in this level Mr. Reid wishes to maintain a constant current. The plan you suggest would prevent the air getting into the suction-pipe, but would not keep up the current.

Mr. Reid (Haddington)—Is the air drawn in; and how does it affect it?

Mr. Robb—Suppose the area of the well is extensive, the tar cools at the mouth of the pipe, and, during the action of the pump, suddenly breaks away, or unseals, leaving a considerable gap, and it takes a long time before you can again seal the tail-pipe We had a stoppoge for some time in consequence of the thickening of the tar.

Mr. Whimster (Perth)—If Mr. Reid was to make the suspending wire, on which his float is hung, a tube, so that it would rise and fall with the well, and shut and open the cock, would he not prevent air getting into the pipes? He would simply pump the tar, and what was not wanted would return through the tube and be pumped over again.

Mr. Hall—Since the difficulty is keeping the air out of the pipes, I suppose Mr. Reid wishes to prevent the tar from cooling and unsealing the tail-pipe.

Mr. Reid—The pump throws up the tar into an open cistern, and all the air escapes. There is not a particle of air gets into the pipe at all.

The President—I think the explanation Mr. Reid has given will satisfy all that this apparatus is well designed to overcome the difficulty he met with. It is only by gentlemen coming here and explaining how difficulties arose with them and were met that we are enabled to overcome them, and I am sure the members of the Association are very much indebted to Mr. Reid for bringing forward this matter.

Mr. Robert Mitchell (Coatbridge) read the following paper on—

THE CONDENSATION AND TREATMENT OF GASES BY THE AITKEN-YOUNG PROCESS.

Two months ago I was favored with a visit of your honorary secretary and Mr. Myers, of Broughty Ferry. The new process of treating gases under condensation was talked over, and I was asked to prepare a short paper on that subject. At that time I declined, thinking that some other members would come forward, who had lately been more immediately connected with the process. No one coming forward, however, and being again asked, I felt it my duty, as a member of the Association, to lay before you what little I know of the subject.

It must be apparent to every observer, the improvements which have been made in the various branches of industry within the last few years; still the process of gas making, as carried on in our moderately-sized works—in fact, nearly all—is just the stereotype of what was in use 20 years ago. There have been a number of minor improvements, but virtually it is the same method of carbonization and condensation as at the period referred to.

The process to which I purpose drawing your attention has been before me for a considerable time. I had the privilege of being an assistant to Mr. Young during the whole time this process was being carried through its various stages, until it reached the success which it now has attained. During the whole of that period the laboratory and all the apparatus were open to me. All the experiments and analyses were most carefully gone into and noted, with all the particulars which marked their progress; on the under-

standing, of course, that at that time all my observations were strictly confidential.

Our general aim in carbonizing coal is to conduct the distillation at such a temperature as will produce the greatest volume of gas capable of giving the greatest amount of light. To arrive at this, care must be taken that the coal is not subjected to too high a temperature, in which case the constituents of the coal are over-decomposed, and converted into the denser hydrocarbons, marsh gas, etc., giving when consumed a very low illuminating power.

On the other hand, when the distillation has not been carried on at a sufficiently high temperature, the constituents of the coal are not sufficiently decomposed; hence the large quantity of liquid hydrocarbons formed, a large portion of which is capable of being permanently diffused through the gas, and which would improve, to a very considerable extent, the illuminating power. But owing to the coal being so distilled, and the gaseous products being so small in volume, they are only able to absorb a very small proportion of the total liquid hydrocarbons; hence, at low heats, the total sperm value is very small.

You will also observe that the gas produced at a high temperature, and which has undergone excessive decomposition, and formed these denser hydrocarbons, will absorb from the gas any portion of the lighter hydrocarbons which may have escaped decomposition, unless certain precautions are taken during its condensation. One of these is the keeping of the tars in a heated state, thus negativing the affinity of the tar for the volatile hydrocarbons, and causing the gases to pass away, holding in diffusion a considerable amount of the hydrocarbon vapors which, in the usual method of condensation, would be found in the tar; thus showing that the tar has an affinity for, and also a solvent action on, hydrocarbon vapors suspended in the gas.

It is, I presume, an undisputed fact that the luminosity of the gas is, to a large extent, due to the presence of the volatile hydrocarbon vapors, and which may be determined by a very simple experiment. I have here three jets. No. 1 is for the purpose of consuming the gas as supplied by our friend Mr. Watson. No. 2, as you will observe, is connected to the top of a Woolfe's bottle, in which is contained a dead oil. No. 3 is attached to a similar bottle, in which is contained a quantity of very volatile hydrocarbon fluid. You observe that No. 1 presents a flame, the luminosity of which is all that could be desired. No. 2 is so far reduced that I fear a few members in the back of the hall will be unable to see it. In No. 3, by presenting the gas which has been robbed of nearly all the light-giving constituents by passing through No. 2, we have a flame highly luminous, showing conclusively that the increased illuminating power is due to the presence of the volatile hydrocarbons suspended in the gas.

After having thus demonstrated that the illuminating power is in proportion to the presence and constitution of these vapors, a question very naturally suggests itself—How can we retain, or what process can be brought into operation so as to suspend or allow the gases to carry in diffusion, and permanently preserve, these vapors, so valuable for light-giving, instead of allowing them to be sold in the tar at a merely nominal rate?

The process, as patented by Messrs. Aitken and Young, and known as the Analyzer Process, meets this in a most successful manner. This piece of apparatus consists of a large vertical chamber, into which are fixed tray diaphragms, placed and arranged so that the gases passing through it have to go alternately from side to centre of these trays, each tray being so formed as to contain about two inches of the hydrocarbon liquid. The centre apertures are supplied with wire gauze tubes, which dip into the diaphragm under it, so that all the gases passing have to come into contact with the liquid on each of these trays. The bottom of the apparatus is fitted up either jacketed or supplied with a steam coil, which serves to keep the tars heated up to a sufficiently high temperature (say 225°), or sufficient to volatilize the light hydrocarbons they contain. The gas and tar pass into the analyzer by the same pipe. The gases at this point are carrying in diffusion tarry matter. The volatile hydrocarbons thrown off by the partial distillation of the tar have an affinity for, or, in other words, the power of uniting with, these tarry particles, and separating as they pass through the first wire-gauze tube, which is suspended from the second tray.

As I have already stated, these trays are so constructed as to contain over their whole area about two inches of the hydrocarbon liquid. When these get overloaded, the liquid falls into the tray below it, and so on until a portion of it reaches the bottom, where it is either revolatilized or run to the well. The gases at this stage, still carrying a small portion of the tarry matter, are subjected to a series of washings with this distillate, and as they ascend through the various tray diaphragms they deposit the heavier hydrocarbons, still carrying in diffusion and absorbing a quantity of the more volatile ones from the remaining trays the quantity of which shall be in proportion to the quality of the bituminous material carbonized, and the manner in which the carbonization has been conducted. As nearly all the tarry matter has been left in the analyzer, the gases flow on to the scrubber at a temperature of somewhere about 75° Fahr., thence to the purifiers, where the advantages of the process are not less remarkable.

Having given a general outline of the apparatus and the mode of working, I will confine my further remarks to the advantages, or the applicability, of this process in the manufacture of gas having a high illuminating power.

You are all thoroughly conversant with the advantages to be derived from the use of some inferior gas producing material, along with those high-class cannel coals of ours, which, if distilled alone, the gases would be able to convey to the point of combustion only a small portion of the hydrocarbons formed, whereas by the employing of a material producing gas of a comparatively low illuminating power, but rich in volume, we secure what serves as a medium for carrying in suspension those surplus vapors produced from the rich coal, and retain them in a permanently gaseous state to the point of combustion—hence the sperm value by so mixing is increased. Now, gentlemen, I consider that one of the great advantages of this process is, that all hydrocarbons suitable for diffusing through a gas and adding to its illuminating power are perfectly utilized. From the nature of the process, should there be a surplus of hydrocarbons in the gas, at any particular stage of the distillation, they are condensed, and left behind in the upper trays of the analyzer, in the manner I have already indicated, and they are there stored ready to carburet any poor gas which may be presented to them. Indeed, the experiments in which I more particularly assisted Mr. Young, perfectly convinced me of the advantages of this process.

Those experiments consisted of an adaptation of, what you all know as the hydrocarbon process, which I had previously looked upon as impracticable, owing to the difficulty of producing a gas of uniform quality; that quality being entirely dependent on the skill of the operator, from the necessity there was in blending the water gas (hydrogen and carbonic oxide) with the hydrocarbon gas, in exact proportions, so that he might take the surplus hydrocarbon produced from the bituminous material during the process of carbonization. When the water gas (hydrogen and carbonic oxide) was passed in too small a quantity, the hydrocarbons, instead of being taken up, were deposited, run to the tar well, and lost. On the other hand, when the water gas (hydrogen and carbonic oxide), was in excess, the hydrocarbon gas was diluted, and thereby deteriorated in its illuminating power. Therefore it can be easily observed it would be difficult to regulate the proportions.

By this new process, the difficulty just indicated, in my opinion, is very much modified, if not entirely overcome, for it is not necessary that the gases be generated and blended simultaneously in the proper proportions. Should there be a deficiency of the water gas, the surplus hydrocarbons are deposited in the analyzer, and there stored up to carburet the water gas (hydrogen and carbonic oxide) when a superabundance is added. All that is necessary is to make sure that the quantities necessary for giving a certain quality are produced.

An instance of one of the experiments made will illustrate more fully my meaning.

One of the shales employed in the experiments gave us a yield of 38-candle gas by the ordinary process. When a charge of this shale was passed through the analyzer, the surplus hydrocarbons were there condensed and deposited. The gas from a charge of a common splint coal, yielding 8500 cubic feet of 17-candle gas, was then passed through the analyzer, the illuminating power was increased to 25 candles, thus showing that had those two materials been distilled separately and mixed, there would have been produced 14,769 cubic feet of 25·91-candle gas, whereas by employing the hydrocarbons from the rich shale there was produced the same quantity of gas, but having the very superior illuminating power of 30·52 candles.

If we wish to have a gas from those materials of 30·52 candles, all that we have to do is to work them in equal proportions, when the analyzer will secure that the whole of the volatile hydrocarbons are diffused through the poor gas, whether they be worked together or not.

Again, this same shale, on being distilled and passed through the analyzer, the surplus hydrocarbons deposited there, steam then admitted into the retort, and there decomposed by the fixed carbon, until the total bulk of the gases were brought up to 10,000 cubic feet, it had an illuminating power of 35·38 candles.

It is thus shown conclusively that the analyzer is capable of fully utilizing the hydrocarbon vapors resulting from the distillation of a rich bituminous substance to carburet water gas (hydrogen and carbonic oxide). In conducting the hydrocarbon process by means of the analyzer, with a given bituminous material to produce a given quality of gas, all that is necessary is to see that from a given quantity of said material a given volume of gas is produced.

Of course, I am aware that in this country, where coal can be had so cheaply, it is not likely the hydrocarbon process will be employed, unless, as Mr. Spice very justly puts it, a coal famine was again to come upon us. In such a contingency, I have no doubt he is quite correct in asserting that his process of manufacturing hydrogen gas, in conjunction with this analyzing process, would be very extensively employed.

My sole object in making reference to water gas is to show the utility of this new analyzing process in storing up and applying the surplus hydrocarbons from a rich gas to carburet a poor one, or from one stage of distillation to that of another. I have every confidence in laying this process before you, as I am satisfied it is a great step in the right direction. And I hope that any little information I have been able to contribute may tend to direct your attention to the subject, so that, by discussing the matter, we may be enabled to judge of the practical utility of the invention.

Mr. Smith—Why is the steam put at the top of the apparatus? Does it not touch the gas?

Mr. Mitchell—The steam never touches the gas; it is only for the purpose of keeping the trays hot.

Mr. Whimster—Is there any chance of the wire gauze choking up?

Mr. Mitchell—It is almost an impossibility.

Mr. Peebles—What size is the mesh of the gauze?

Mr. Mitchell—A quarter of an inch.

Mr. Young (Clippens)—The size is eight meshes to the inch, made of No. 18 or 20 wire. We find that although the apparatus keeps perfectly clear for about three months, it is sometimes necessary to put a little steam into the uprights, so as to float the tars off. I

believe in working the arrangement, it would be better to put in a rougher mesh at the bottom, and finer meshes as we ascend. The object of having three trays is to present a much larger surface, and they do not require so much heat. At Hamilton, there was one jacketed tray, and we were very much disappointed to find that the jacket was not tight, so there was a steam coil put in which was found to answer the purpose admirably. Without trays, any other arrangement by which the tars are kept above the condensing points of the hydrocarbons will give the result, the sole object being to combine the tar-distilling and gas-condensing arrangements in one, so that the tar will be deprived of naphtha, and the gas deprived of tar, which alone will go away into the tar-well.

Mr. Robb—There is one point I should like some information upon. I am exceedingly pleased with the ayparatus, which seems to me to be perfectly true in theory, and almost perfect in practice; but before adopting it to works where the annual consumption is large enough to warrant its introduction, I would like te hear something of the real value of the ordinary cannel coal in using this apparatus. It is stated in Mr. Mitchell's paper that the illuminating power added to the gas, using ordinary second-class coal, is four candles. The Camps coal was used at Hamilton; but it is said to be a superior coal, which anybody, by the ordinary method of working, could make equal to 24 candles, or even 38 candles, with a quarter of Westwood shale used along with the coal. Would it not be advisable to make gas equal to 28, or even 29 candles with one-quarter Westwood shale and three-quarters Camps cannel?

Mr. Fairweather (Barchead)—With regard to Camp coal, I mentioned the matter to the West of Scotland Association, and Mr. Dunlop being present, said he was quite convinced that the report was over what it should have been, and that the actual illuminating power of the coal was only between twenty-two and twenty-three candles.

Mr. Robb—23·9 is in the analysis.

Mr. Smith—I have been watching this apparatus with very great interest. I suppose I am placed the furthest from the coals, with the exception of a few, and anything that can raise the illuminating power of the gas I try to watch, and do everything in my power to adopt it. I must confess that I fail entirely to see in what way this apparatus can raise the illuminating power of the gas three candles, because, by the ordinary process, we are making 28-candle gas, and carbonizing the coal on the most approved principle. If we take the tar from the well, and turn it into gas again, we can get nothing more than 12-candle gas, and how can this tar be turned into 30-candle gas? This is a question I should like answered, as there may be something in the chemistry of the process which gives this result. Another question I would like to ask is What deterioration is there in the value of the tar, estimating it to be worth so much per ton of coals, after condensing by means of this apparatus?

Mr. Stewart (Greenock)—I have myself tested this apparatus, and I have no doubt it would be of great advantage to gas works, as you get by it all the advantages I get by distilling the tars. I get as much for boiled tars as tars which are not boiled.

Mr. Smith—I hope Mr. Mitchell will bear in mind the question I asked. I want to know the value of the products after using this apparatus, and how you can raise the illuminating power of the gas. I read over the West of Scotland Association's report of the process, and one thing struck me on looking over the data—namely, that one of the experiments did not bear out the others. I refer to the condensation by bromine. By the ordinary process the result is the same in all cases, and the condensation by bromine should have gone up like the others.

Mr. Young—I have here a sample of hydrocarbon from which, by passing the gas through it, I can bring the illuminating power up to 80 candles, which is qiuvalent to five cubic feet. By passing it through retort it would produce 50-candle gas. Here we have got all the atoms of the naphthas and tars shrunk up—in other words, the specific gravity of the vapors is something like from four to six times the specific gravity of the gas itself. It very much depends on the quantity of naphtha in the gas what the illuminating power is. Drt Letheby, of London, made a long series of experiments, and he found that a single grain of naphtha increased the illuminating power by 10 per cent. Here we have our coal tars taking away, not the most volatile portions of the hydrocarbons, but the very densist portions. Perhaps this will also account for the low condensation from bromine. We know if we take the condensed matter and analyze it, we find its constitution is something like that of benzole, and if we condense the matter from the Newcastle coal, we find that 4 per cent. of condensation represents 12 candles, while 4 per cent. of Boghead coal represents 20 candles. We can easily understand that, seeing the gas have taken up and hold in suspension all the more volatile portion of the matter, they will receive more illuminating power by the condensation of the denser portion. If we could only find the means of getting gas with all its carbon, we should have a very high illuminating power, but seeing we require to put it through a retort, we lose some of this power. As to the relative value of the products, that is a thing only time and the market will decide. The whole you do with the tars is simply to take away the naphtha, and two-fifths of the whole tar made in Great Britain is sold as boiled tar. Whatever the product you will be the gainer, because if you do not get the value of the hydrocarbons in your gas, you will get it in the products you sell.

Mr. Stewart explained that with regard to the price of boiled tars, he had the greater part of the world as a market to sell it in.

Mr. Whimster—I would like, if we could, to get at the exact results that have been realized from this process per ton of coal. If the coal is carbonized, and the tar resulting from it is treated in this apparatus, how much illuminating power will it add to the gas, and what increase in quantity will there be, taking any coal you like?

Mr. Reid—To my mind another question is also of importance. What is the effect of the absorption of these liquid hydrocarbons in regard to severe temperature, what would be the result?

Mr. Whimster—I understand this gas is permanent gas, and I put my question on that understanding.

Mr. Scott (Musselburgh)—Will it be stated, in plain words, what would really be the advantage of this apparatus in regard to the quantity and quality of gas from a fair coal?

Mr. Peebles—I still think Mr. Smith's question, as to the deterioration of the present value of the tar, should get a distinct answer. I am quite certain, from the open and above-board way in which everything in connection with this process has been gone into by the patentees, that they are willing to give every information in their power.

Mr. Whimster—Might I say that the volatile naphthas derivable from coal tar in the ordinary process are worth 2s. 4½d. per ton of coal, and that the result in tar is better than the tar would be from this process, in my opinion. If the naphtha of an ordinary tar, obtained by the ordinary process, can realize a clear profit, and we have residual products equal to what you have, is not that some advantage?

Mr. Robb—If it were stated what is the per centage of loss in naphthas and hydrocarbons in the tars, from any ordinary coal we are in the habit of working, we could culculate the loss to us who depend for the sale of our tars on the proportion of naphtha,

Mr. Mitchell—I do not see where Mr. Whimster can get his 2s. 4½d. per ton of profit, because, taking Dr. Letheby as an authority, an English coal which yields half the quantity of Scotch, gives one-third of crude naphtha per ton. I had no intention of touching on the experiments conducted at Hamilton; I merely took up the subject on its merits. If this Association has any wish to go into experiments to answer these questions, I have no doubt the patentees will only be too glad to co-operate in the matter.

Mr. Young—It is quite natural to suppose, seeing that we have to pump hydrocarbons from the dip-boxes, that we are all agreed as to their value. Our present mode of condensation is a very crude one. We separate the benzole from coal tar by one or two or more operations, to fractionize the matter, while there should be a series of condensations, and hence the reason why the hydrocarbons are not properly fractionated, and the naphtha in the tar is not fractionated. By this process the tarry particles are sifted out, the analyzer arrangements having a fly-wheel action. The present method is simply to condense the tars from our gases and run them to the tar well! there is no fractionating process. I have no doubt that from a rich coal 2s. 4½d, worth of naphtha per ton can be got. One single grain of naphtha, added to a cubic foot of gas, increases the illuminating power 10 per cent., and the naphthas are worth three times what they realize separately when they are diffused through the gas. Here the whole process of condensation and fractionating is conducted in one single operation, and if it is good to put so much hydrocarbon in our gas, why should we not put in more? It is surely more profitable to diffuse hydrocarbons through gas than to sell them in separate naphthas,

Mr. Whimster—I quite agree that this is the best process of utilizing the volatile portions of the tar. It is not a new idea (and I think it is one in the right direction) that we ought to aim at any fractional distillation of secondary products. Nay, further, it is absolutely necessary to get our gas to carry away all it can. What I want to know is, will it benefit me to turn from the process of tar distillation to this process with its secondary products? I say, with my heats and rich coal, we aim at producing gas equal to 27 candles. What results have been realized from the working of this process—what definite results? what increase of illuminating power? what increase in quantity? I say we can get tar from a ton of coal by the ordinary process, yielding six gallons of naptha of about 885° to 890° specific gravity, and from that we can get at the rate of 2s. 4½d. per ton of coal, after clearing the expenses of the proces, and we have besides the tar boiled ready for the market, and all the ammonia in the tar separated from it; so that I hold that our tar is better than that produced by this process, and is as great in quantity. Will it benefit me anything to turn from the present process and adopt this one? We are practical men, and do not cavil at inventions; we are inventors ourselves, and are very glad to see inventions brought out, and we praise and forward them. I am just as ready as any one to give all the praise that is due to the patentees of this process, which seems beautifully adapted for the object it has in view; but what is the benefit of it to us as gas managers?

Mr. Monk (Lanark)—Do I understand Mr. Whimster to say that six gallons of naphtha are got from a ton of coal?

Mr. Whimster—It is 1·6 gallon. I am sorry I left my book with the calculations at home, but any one who wishes can see them.

Mr. Blair (East Wemyss)—In taking a ton of coal, and taking the product from it, what is the weight of the tar, the weight of the water and the coal, and if there is an increase of illuminating power, how much is it?

The President—I scarcely understand your question?

Mr. Young—I think he means to ask whether there is any change in weight. That has not been proved yet; but I expect there will be no change, for the simple reason that this process does nothing but fractionate the tar; it simply divides the napthas from the tars in the process of condensation. Instead of having the weight of the naphthas in the tars, you have it in the gas. The ammonical water is exactly the same, and the ammonia is also the same.

Mr. Reid—In short, nothing is annihilated

Mr. Monk—Whether is it better to put the naphtha into the gas or drive it way?

Mr. Mitchell (Dundee)—The meeting can only judge of the merits of this process if there are some practical details given to show in the ordinary working

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that an ordinary coal produces a certain quantity of gas of a certain quality. If Mr. Mitchell had been able to show what this ordinary plan of ours would turn out if this analyizing process were adopted, we would have been in a better position to give an opinion. At present we take up a certain quantity of naphtha—about two-thirds of a gallon per ton of coal—and if it could be shown practically what the result would be in quantity and quality by this new process, taking such coal as we use at present, it would be more satisfactory.

Mr. Smith—I do not think the patentees can show they can get more gas by their process; the only thing they claim to do is to raise the quality of the gas.

Mr. Young—Supposing the coal was equal to 10,000 cubic feet of gas, 9·8 grains of naphtha for every cubic foot at 5 per cent. per grain, would be 50 per cent. of increased illuminating power, were it possible to use the whole of the naphtha. If you want to economize the hydrocarbon, it is essential to employ some poor coal to use up the surplus of naphtha. It is quite evident that from poor coal you will not get the same quantity as from a rich coal, but if all the naphthas were diffused through the gas it would add 50 per cent. to the illuminating power. Dr. Wallace admits that at Hamilton there was 1·7 per cent. of such a naphtha in the product, but that was evidently unsuited to diffuse through the gas we were making. To utilize your naphtha vapors you require to use poor coal. I have not the least doubt that the further this matter is investigated you will be the more convinced that every grain of naphtha you employ in your gas is worth three times more per ton of coal than by selling it separately. Dr. Letheby points out that there is an increase of illumminating power to the extent of four per cent. for every grain of naphtha, and in many cases of ten per cent. It was asked whether there would not be a danger from condensation taking place in the gasholder in a low temperate. Seeing that not only do the denser vapors get away, but carry down a great many of the lighter ones, I think any gentleman may safely make the experiment, keeping the tars long enough in contact with the gas at a temperature sufficiently high to take away the volatile vapors

Mr. Monk—In drawing up the report of the West of Scotland Association, we anticipated all these questions, and have given there the value of the naphthas, and the per centage of naphtha in the tars in each process, and also the temperatures and the balance of sperm per ton, so that each man may calculate the value of this process, and whether it is best to convert the naphtha into gas or sell it as naphtha. I look upon the process as the perfection of the condensation of illuminating gas, and I speak from general observation, both in Europe and America. In reference to Mr. Robb's remarks as to the analysis of cannel coal, we did not take that coal for analysis; we took the coal that was lying at hand. In the reports appearing in the Journal of Gas Lighting of the 15th of May, we gave the products of the whole. We took the coal as it was lying, and put so much of it through the retorts in the ordinary process, and so much through this apparatus. The heats were about the same—about 1800° or 2000°, a good white heat at the back of the retort, and not so hot in front. I think these comparative results are far more reliable than those obtained from analysis. This question has been put and answered before. I would refer to a letter which appeared in the Journal of this week from Mr. Key.

The President—As Mr. Key is not here to defend himself, I think you should not refer to his letter.

Mr. Hall—This discussion has certainly gone on for a great length of time; but I have one point more which is applicable to some of us. I think the discussion has been chiefly confined to those parties who can utilize their tars and naphthas, and find a ready market for them. But in small works we find a difficulty in disposing of our tar and naphthas, and some have to give them away for very little, and I say that if this process can add to the quantity and illuminating power of our gas, it will prove of great benefit to the managers of small works.

Mr. Hislop—I think we must be all of one mind in regard to the simplicity and beauty of this arrangement. The whole question seems to resolve itself into a question of commercial value. The results have already been furnished in the Journal of Gas Lighting, and, after the experiments exhibited, it remains for each man to determine whether, according to his circumstances as to the disposal of the tar, it would be an advantage to use this process or not. At the same time I think it well that the patentees of this process should prosecute the thing further, and endeavor to satisfy the minds of the managers throughout the country as to the utility of the process, and the advantage to be derived from it. In certain cases it would be certainly an advantage while in others it might be the reverse.

Mr. Rabb—I see that if we were to adopt this process, we would have to face a large increase of plant, and we would be obliged to use a much higher class of coal, so that I am afraid in the end we would not profit by the change.

Mr. Young—If you use a high-class coal you have a certain quantity of naphtha left in the tars, and if you use poor coal to take it up, you get the benefit in your gas. It is not necessary to increase the plant, it is only necessary to use a poor coal to take up the surplus of the hydrocarbon given off from the rich coal. The poor coal is to be utilized for that reason. We mix the coal at the present moment, and get the poor coal to carry away the hydrocarbons. This process is simply to utilize the vapors by diffusing them through the gas.

Mr. Mitchell—Mr. Young has so fully answered every question that I find it unnecessary to add anything to what he has said.

The President—I am sure we thank Mr. Mitchell for the able and intelligent exposition he has given of this beautiful process. No doubt a considerable quantity of hydrocarbons remain in the tar, and the question simply comes to be—Is it more profitable to analyze the tars and get the naphtha diffused through the gas in the form shown by Mr. Mitchell, or to use the tar in the ordinary way? Whether is the naphtha more valuable than the extra illuminating power diffused through the gas? At the same time, I cannot think there can be the slightest do , if the permanency of the gas is established, that this process would be beneficial to small places where there is a difficulty in getting the tar removed, and where it has to be given away for a trifle. In other places the advantage would not perhaps be so great. On the whole, I think this is a process well worthy of our consideration, and if Mr. Young can show that for every grain of naphtha diffused through the gas there is an increase of 5 per cent. in the illuminating power of the gas, I think there will be no doubt of its success. The difficulty will be in getting the naphtha so diffused through the gas as to make every grain equal to that increase. I think we are entitled to give both Mr. Mitchell and Mr. Young a hearty vote of thanks for the manner in which they have brought forward this important and interesting subject.

Contributions to the Theory of Luminous Flames.

BY DR. KARL HELMANN.

[Translated from the "Journal of Gasbeleuchtung."]

PART II.

[Continued from page 115.]

Effect of Diminution or Increase of Heat on Luminous Flames.—The phenomenon already noticed of a small space between a flame and the burner, or any other cold body that touches the flame, is most conspicuous in feebly luminous flames strongly diluted with neutral gases, but it may be also quite clearly observed in ordinary luminous flames. The observation in the latter case becomes more difficult, because the eye is dazzled by the brightness of the light; but by holding a suitable screen before the flame, in such a manner as to cover the bright portion as completely as possible, this difficulty may be in a great measure overcome.

I have already alluded to the well-known fact that a flame is deprived of part of its luminosity if it is depressed or expanded by means of a cold body, and a suitably-devised experiment afforded the proof that the diminution of the light was due solely to the withdrawal of heat.

Taking this result in connection with the appearance of a space between the flame and the body touching it, which I have already spoken of—that is, if we institute experiments on these spaces with luminous flames, at the same time noting the simultaneous alteration in the intensity of the light, we arrive at results, easy, indeed, to be forseen, but leading to conclusions of practical interest.

If a cold metal wire is introduced into a luminous gas or candle flame, it is seen that the flame is quite extinguished in the immediate vicinity of the wire, while the luminosity is diminished through a much wider circle. Though gases are exceedingly bad conductors of heat, in this case the upward movement and great diffusibility of the gas assists the abstraction of heat by constantly bringing fresh glowing gas particles into immediate contact with the cooling wire. The effect of this abstraction of heat must, therefore, necessarily make itself felt at a distance from the wire, greater in proportion to the coldness of the wire itself; if the wire is only of small diameter, its temperature will in a comparatively short time be raised so high that the constantly diminishing abstraction of heat at last becomes too slight to produce any perceptible diminution of light.

The area of the extinguished as well as of the disilluminated gas will, therefore, with a thin metal wire, be greatest in the first moment of its introduction into the flame; the two concentric areas will diminish as the wire grows hot, and finally disappear from observation when the metal has become glowing hot.

With a thick metal rod, on the other hand, a decrease of the two areas will not take place until a certain balance is attained, and the temperature of the rod is so far raised that all the additional heat received only just suffices to replace that lost by radiation and conduction from the metal. It follows from this that a metal body of some thickness can permanently affect the luminosity of the flame touching it.

As it is generally a matter of indifference into what part of the flame the refrigerating body is introduced the head of the burner will evidently also have a disilluminating effect, and the more or less extended dark portion of the flame close to the burner is in no small degree due to this refrigerating power of the burner.

Before I enter further upon the partial disillumination or diminution of the light of a flame by the burner, and the rush of the cold gas escaping, it seems necessary to examine more closely the manner in which disillumination may be caused by the refrigerating effect of a cold body introduced into the flame. If a luminous gas-flame, for instance, is slightly depressed by a porcelain saucer, the flame loses some of its light, and the porcelain becomes covered with a thick layer of soot. But if the refrigerating object is at once quickly immersed as far as the lower half of the flame, the light disappears entirely, and the porcelain is not sooted in the least.

I have shown before that the extension of the flame and its consequences are immaterial to the case in question, and that the disillumination must be attributed to abstraction of heat by the cold body. If, therefore, in each case, an equal surface of the porcelain plate is allowed to be in contact with the flame, which may easily be arranged, the refrigerating effect will be pretty nearly equal,* and yet the plate becomes covered with soot if it is in the upper part of the flame, but not if it is in the lower portion. To

* The upper and more intensely heated portion of the flame will part with rather more heat, in a given time, to the porcelain plate than the lower portion, on account of the greater difference in temperature.

ascertain the cause of this difference in the flame zones, the following experiments were made:

A white porcelain rod introduced into the lower half of a gas-flame issuing from a round opening (8 millimeters in diameter) caused the light-envelope (*lichtmantel*), which was here only thin, to become perfectly blue to a wide extent. This was easily perceived when the eye was protected from the dazzling effect of the still luminous portion of the flame by a screen. No deposit of soot was to be seen on the rod even after a lengthened period. Held in the upper portion of the light envelope, the rod was immediately covered with a layer of soot, which soon became of considerable thickness. In this case also diminution of light was very clearly perceptible.

To explain these phenomena, which any one may verify, I venture the following hypothesis, which I shall endeavor to substantiate in the progress of this article:

The carbon-containing materials forming the light may burn in two different ways, viz., luminously, that is while giving off carbon in the flame; or non-luminously, that is without this intermediate process of carbon-separation.* For the first mode of combustion, a certain high degree of heat is necessary, depending upon the nature of the combustible, while any portion of the flame which by any means is prevented from attaining that limit of temperature cannot effect this separation of carbon. Combustible gases, if diluted by a neutral gas, require a higher temperature to effect this separation than they otherwise would.

With reference to this last point, which has also been previously touched upon, chemistry offers many similar examples of diluted solutions not being decomposed, precipitation effected, etc., unless they are heated; while in concentrated solutions, the same effects are produced at a much lower temperature. The different portions of a luminous flame are of very unequal temperature, and a cold body introduced into the flame, and abstracting in each case nearly† the same amount of heat, will only cool the hot upper portion of the flame to a small extent below the temperature requisite for the separation of carbon, which process, therefore, continues undisturbed in the immediate neighborhood. Besides this, carbon is already separated in the part of the flame below the cooling body, and the particles being carried upwards, strike against it and deposit soot—a condition which is usually present, though by suitable arrangements it may be obviated. Therefore, in the upper portion of the flame, a body introduced would become coated with soot (but, of course, only on the lower surface), even though for some distance round the cooling body the temperature were so reduced that no separation of carbon could take place. But if the cooling body is inserted into the lower, less heated portion of the luminous envelope, the temperature of the flame is reduced below the lowest degree absolutely requisite for the carbon separation for a considerable distance round; neither illumination of that portion of the flame, nor yet a deposit of soot, can, therefore, take place, and the less so as, if the porcelain rod is properly placed, the separation of carbon lower down in the flame, as just alluded to, will not occur.

Reverting now to the experiment which induced the consideration of the action of the different portions of the flame-envelope, we find the fact of the coating of a porcelain saucer with soot, if slightly pressed on a luminous flame, explained by two circumstances, viz.:

1. The diminution of heat is not sufficient to reduce the very hot flame-gases below the lowest temperature requisite for the separation of carbon to any distance around; and

2. The particles of carbon, separated in the lower, uncooled portions of the flame rise and attach themselves to the saucer. The non-deposit of soot, but complete disillumination of the flame, when much depressed by a cold body is, on the other hand, explained by the early cooling of the flame, preventing it from ever attaining the degree of heat necessary for the separation of carbon.

These considerations teach us that where a large deposit of soot is required (as in the preparation of lamp-black, or for the annealing of blown glass), the flame must not be too much cooled, but must contain sufficient heat to effect as complete a separation of carbon as possible. On the other hand, too high a temperature and unlimited access of air are prejudicial, as a large proportion of the carbon is then consumed. They show further that a cooling of the flame is, in fact, not necessary for the deposit of soot, because the carbon is not separated within the flame, in consequence of the diminished temperature; but, on the contrary, a high temperature is the very means by which this separation is effected. The cold body introduced into the flame rather acts as a rampart to receive the bullets discharged, and its refrigerating action only furthers the process, in so far as it prevents a greater combustion of the carbon suspended in the flame, or of that already deposited. It necessarily follows that a deposit of soot will take place even on a glowing surface immersed in the luminous flame.

In a flame without smoke, all the carbon separated is consumed, partly in the interior of the flame, partly in its outer envelope, but this combustion will be less perfect where the flame is bounded, not by the air, but by the solid body in contact with it. Nevertheless, even here the access of air is not completely prevented, and, therefore, a portion of the deposited but still glowing soot, will continually be burned. The deposit of soot on a glowing surface is, therefore, not quite so large as in one less heated; but, with a very cold body, it may occur that the soot deposit, under certain circumstances, becomes much smaller, or even will not take place at all.

In experimenting to prove that a glowing-hot object will have soot deposited upon it by a luminous gas-flame, care must be taken not to expose the surface to the air while at such a high temperature, otherwise all the soot will, in an extremely short space of time, sometimes even instantaneously, be consumed and disappear. The best plan is to heat a platinum saucer vertically suspended, by means of a Bunsen lamp fastened horizontally, and directed against the concave, and when glowing hot to direct a gas-flame, issuing from a tube, against the convex side. The disappearance of the brightness of the surface will of itself show a deposit of soot.

If the gas-flame is moved aside slightly, the soot, now exposed to the air, will immediately burn with a bright heat.

But by waiting until the layer of soot has attained some thickness, and then simultaneously removing both the light and the heat flame, though a portion of the soot will still be burned, the platinum cools so quickly that a considerable portion of the soot will remain unconsumed.

A striking proof that the cooling of the flame is only a subsidiary cause of the deposit of soot, and that the cooling body only acts as a rampart to receive the rapidly moving carbon particles, is the fact that a porcelain rod introduced into the flame is coated almost exclusively on its lower surface, or that exposed to the issuing gas-jet, the upper surface only becoming slightly blackened, and that, after a considerable lapse of time.

This fact is a fresh and important proof that the soot exists in the flame as a solid body, and not, as Frankland supposed, in the form of vapor; otherwise the deposit would be a consequence of refrigeration, and condensation of the dense light-yielding hydrocarbon vapors would also take place on the upper surface of the body introduced into the flame.

My theoretical conclusions had carried me thus far when I saw the disseration of M. Vogel on the increase of illuminating power by heating the gas, and the diametrically opposite conclusions arrived at by the London Gas Referees.

M. Vogel passed the gas through a U-tube, which was immersed successively in ice, a refrigerating mixture, boiling water, and heated paraffin. A steatite burner was fixed immediately on the sexit end of the U-tube, so that the gas was burned as it issued. The photometric observations, taking the intensity of the light at +18° as 100, yielded at 0° 76 and 85; at —20° only 33 and 44; at +100°, 104; and at +160° 118. This would show the influence of a low temperature to be very considerable, while heating yielded a result which, though not unimportant in itself, was by no means in proportion to the other.

These results were completely contradicted by the report of the Gas Referees, according to which no difference could be observed in the illuminating power of gas at 0° and at 145°. As far as I know, Voge has made no reply to this, and, unfortunately, circumstances prevent me at present from repeating his experiments; but the following remarks on the question generally may assist in elubidating it.

With respect to the practical part of Vogel's experiments, it can scarcely be assumed that the gas issuing from the burner necessarily possessed the given temperatures of 0°, —20°, 100°, and 160°, for, considering the exceedingly feeble heat conducting power of gases, the passage through a single U-tube of a given temperature would certainly not suffice to raise the whole of the gas to the same temperature. A spiral tube, with many convolutions, would be decidedly preferable, and even then it would be desirable to adopt the precaution of inserting a small thermometer in the tube, at the end next to the burner.

In the photometric observations carried out by me with a view to the present remarks, the necessity of keeping an exact record of the gas consumption soon became apparent. I think I may, *a priori*, assume that the quantities of gas actually consumed in a unit of time, with a cooled or heated U-tube, in Vogel's experiments, were not quite identical, and that the resultant figures would perhaps have been somewhat different if the difference in gas consumption had been duly allowed for. However, Vogel's general conclusion as to the influence of the temperature of gas on its illuminating power would not be materially affected by this proposed alteration—probably, indeed, a still greater divergence would be observed in the figures. It is, therefore, a matter for further examination, whether the conclusion of the Gas Referees, that the illuminating power is equal, whether the gas possesses the temperature of 0° or 145°, can possibly be founded on facts.

Unfortunately, the facts accessible to me of those experiments do not contain the details of their manipulation, so that it is impossible for me to decide whether they were carried out with proper care and judgment. So much, however, appears to me clear, that in considering the diminution of the intensity of the light by refrigeration of the gas below its ordinary temperature, the composition of the gas itself is of the most vital importance, and that Vogel's experiments can only be effectually verified by employing a gas of the same composition. It is quite possible that two descriptions of coal gas, which at 18°, with equal consumption, show the same intensity of light, would at 0°, or —20°, differ very considerably, one losing much, the other but little of its intensity. A gas owing its brilliancy chiefly to a large proportion of ethyl would, even at a low temperature, emit much light, while a gas whose illuminating power depended chiefly on the presence of benzole and similar vapors, must experience a considerable diminution of light by refrigeration. One may say, therefore, that when Vogel observed a considerable diminution of brilliancy by refrigeration, while the gas referees quite contradict this, it only proves that the latter used a gas very poor in condensable hydrocarbons. On the other hand, in the increase of brilliancy by heating the gas observed by Vogel, any influence of the composition of the gas is not so evident or certain, for that a fresh formation of more condensed hydrocarbons should take place as quickly at 100° or 160°, is somewhat doubtful. On the other hand, every increase of heat must, of course, increase the brilliancy of the flame, so that Vogel's results may, to a certain extent, be anticipated as self-evident; and yet the report of the Gas Referees asserts that no increase of brilliancy took place.

[To be continued.]

* I decidedly hold to the view already expressed as to the luminosity of such flames being occasioned by the separation of solid carbon; and in a future essay I shall bring fresh proof of the correctness of this view.

† See last note but one.

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TUESDAY, OCTOBER 2, 1877.

Phosphor Bronze.

A paper on this subject was read before the Society of Arts on April 26, by Mr. Alexander Dick. The chair was occupied by Mr. W. H. Hartley, F. R. S. E.

Having remarked on the fact that bronze had been known probably for 4,000 or 5,000 years, Mr. Dick gave a brief account of the experiments which led to the employment of phosphorus in the manufacture of bronze. These were undertaken in 1868, by Messrs. Montefiore & Künzel, of Liége, Belgium. These gen lemen observed that the tin in bronze continually decreases by oxidation during the process of smelting. Bronze containing 10-10 per cent. of tin was found to contain only 8·52 per cent. after four smeltings. The oxide of copper formed during the process could be eliminated, by "poling," a process by which the molten metal is stirred up with a wooden stick, but after various experiments the oxide of tin still remained. It was in consequence of this difficulty that Dr. Kinzel, for the first time, introduced phosphorus into the molten bronze; this had the desired effect, and the metal, which at first had a dull and covered appearance, suddenly became bright and of metallic surface. Thus, by introducing a small proportion of phosphorus, or phosphuret of tin or copper, of previously ascertained composition, it was found that the total amount of oxygen contained in the molten metal could be ascertained analytically with perfect certainty.

Bronze thus deoxidised was found to be greatly improved in tenacity and elasticity, besides that its qualities became changed, the grain or fracture became finer, the color brighter, the resistance to strain and compression considerably increased, and when melted it attained greater fluidity.

Just as minute quantities of carbon alter the physical properties of iron and convert the latter into steel, so a minute quantity of phosphorus changes those of bronze and converts the same into phosphor-bronze. It may thus be sa d in a certain sense that what steel is to iron phosphor-bronze is to ordinary bronze.

Mes-rs. Montefiore and Kunzel experimented with various combinations of metals, but phosphorus was found to be the only ingredient which will improve bonze by giving reliable results.

The action of phosphorus is twofold—firstly it eliminates the oxides as stated above; and secondly, it makes the tin capable of adopting a crystalline structure—and, as two crystalline metals form a much more homogeneous alloy than two metals of which one is not crystalline, phosphor-bronze must necessarily be more homogeneous than ordinary bronze. Homogeneity and absence of oxygen increase the elasticity and absolute resistance of the alloy.

Another great advantage of phosphor-bronze is tha. its hardness can be regulated by varying the proport tions of phosphorus, which, in ordinary bronze, is done by increasing the proportion of tin, whereby the danger of segregation in the casting is greatly augmented. Ordinary bronze, after one or two smeltngs, becomes thick-flowing and putty-like, whils phosphor-bronze remains perfectly liquid until the moment it sets (solidifies); if, therefore, it is cast just before the "setting" takes place, no segregation is possible.

Combinations of phosphorus with copper, with tin, or with other metals, have long been known by chemists, but Dr. Kunzel was the first to employ the same for the purposes above stated.

A number of phosphor-bronze alloys are now manufactured, varying in composition to suit the objects for which they are intended. The scope of their applications is of course very great. The harder alloys are used for casting bells, tools for gunpowder mills, etc.; other somewhat softer alloys are used for engineering purposes, and the still softer for rolling, drawing, and embossing, etc.

Numerous experiments were recorded showing the extreme tenacity of phosphor bronze. At Berlin a bar was tried under a constant strain of 10 tons per square inch, and resisted 408,230 pulls; a bar of ordinary bronze broke even before the strain of 10 tons per square inch had been attained. A second bar of phosphor-bronze was tried under a strain of 12½ tons per square inch, and withstood 147,850 pulls, and a third bar, under 7½ tons strain, broke only afte- 3,100,000 pulls. On the bending machine phosphor- bronze, whilst under nine tons strain per square inch remained unbroken after 4,000,000 bends, whilst ordinary bronze broke after 150,000 bends. It had also been found that sheets of the alloy stand the action of sea water much better than copper. In a comparative experiment made at Blankenbergh, lasting over a period of six months, between the best English copper and phosphor-bronze it was found that the loss in weight due to the oxidising action of sea water averaged for the English copper 3·058 per cent., while that of the phosphor-bronze was but 1·158 per cent., or about one-third Several governments have experimented on the use of the alloy for making cannons. Without any exception, the results showed a much greater resisting power over that possessed by ordinary bronze.

Some handsome specimens of various tools, harness, etc., were shown, made of phosphor-bronze. In the course of the discussion two speakers stated that phosphor-bronze had been tried for 30-inch bearings at the Llandore Steel Works Rolling Mills, where they were subjected to gritty friction, and it was found that this metal did not wear nearly so long as gun metal, and had consequently been given up.—*The Ironmonger.*

On Boiler Incrustation and Corrosion.

[Read before Section G, British Association, Glasgow Meeting, September, 1876.]

BY F. S. BOWAN, LONDON: E. AND F. N. SPON.

Among the various duties which water has now to fulfil, not the least important certainly is to serve for the generation of steam, and its varying fitness for this purpose often occasions no little perplexity. For incrustations a number of remedies have been proposed, some of which, like a quack life-pill, are warranted to answer in all conceivable cases, whilst in reality they are not useful in any. In most cases the author considers soda-ash as the best preventive. Under its influence the sulphate of lime is decomposed, and the carbonate obtained both from this source and from the bicarbonate of lime is deposited as loose powder incapable of forming incrustations. With intelligent supervision there is no fear of any unpleasant results. Where the impurity consists mainly of sulphate of lime the soda-ash may be added to an external feed-tank or cistern instead of into the boiler. Lime and zinc have been successfully used against the bicarbonate of lime, but in case of the sulphate they are useless. Starchy and gelatinous matters, according to the experiments of M Bidard, rather promote than prevent incrustation. Sodic oxalate and tannate also serve to increase the quantity of the deposit. Sal ammoniac and hydrochloric acid are very limited in their preventive power, and as might have been forseen are liable to inflict serious damage on the boiler and its connections. Raw pyroligneous acid has been proposed in case of carbonates existing alone, and for sulphate petroleum has been used with success. But in waters impregnated with carbonate of lime it is not recommended. Soap makes the boilers filthy, sometimes forms a corrosive crust and promotes priming. A process is also in use which turns on the power of chloride of barium to decompose alsulphates present and liberate the carbonic acid in the water. The author, however, holds that for land boilers the best system is to work in connection with surface condensers, and so supply them with really pure water. This is the more important "in view of the extended use of sectional or water-tube boilers."

Corrosion is apparently a more puzzling phenomenon than incrustation, since it takes places with waters of a high degree of purity, such as the water from Loch Katrine supplied to the city of Glasgow. Carbonic acid and oxygen in solution cause iron to rust away, as was first proved by the late Dr. Grace Calvert, and has been confirmed by more recent observers. The author's concluding remarks are not without significance: "Apart from such a plan there seems no hope of escaping corrosion, and advancing at the same time in engineering practice until it is possible to have copper boilers. And yet, even then, as the recent experiments of Carnelley on the action of water, and of various saline solutions on copper (*Chem. Soc. Jour.*, No. clxiii., p. 1) seem to show, we should still have to combat the same difficulties."

We consider that this pamphlet is well worthy the carefut attention of chemists, to whom it points out a vast and important field for useful research.—*Chemical News.*

Report of the Referees of the Ridgewood Reservoir Contract.

From a lengthy editorial in the Brooklyn (New York) *Union-Argus* of a recent date, we learn that the charges of fraud, both in the granting and conduct of, what has been known for several years in that city, as "the Reservoir Contract" have been finally set at rest by the report of the Committee of Referees—composed of citizens of high repute—appointed by Judge Neilson before whom the contractors for the building of the reservoir, Messrs. Kingsley & Keeney, brought suit against the city, for the sum of $178,000, claimed as the balance due them on their work. The investigation which has been searching and patient, and extending over a period of a year, fully exonerates the Board of city works from the charges of collusion and corruption made against them, and finds that the contract was granted and made to the lowest competitors, according to law; that the work has been carried out in the spirit of the contract, and that the plaintiffs, Messrs. Kingsley & Keeney, the contractors, are entitled to the sum claimed, though they hold that under the present action but $107,000 can be recovered, as that is all that remains of the $1,400,000 authorized to be expended by the city of Brooklyn in the construction of a storage reservoir. It is considered probable that the plaintiffs, though they have established the integrity of their position, their conduct, their contract and their work, since they are awarded $71,000 less than they claimed, which the referees admit is their proper due, will either appeal or seek under some other action to recover the difference between the amount claimed and that allowed them.—*Engineering News.*

Gas-Light Intelligence.

United States.

Gas in Carthage, Mo.—Carthage, Mo., is to be lighted with gas.—*Eng. News*,

Inflammable Gas Found.—Inflammable gas is found near Richfield Springs, N. Y., and it is suggested that the village be lighted with it, as the supply is thought to be abundant. —*Ibid.*

The Louisville Gas Co.—The Louisville, Ky., gas company, groaning under the continuous growlings of people and press, has notified the Council Committee that it will reduce the price of gas to manufacturers from $1.46 to $1.18, and to private consumers from $2.70 to $2 37, if a guarantee will be given that the pipes of no other company will be allowed to be laid in Louisville.—*Ibid.*

Street Lamps in Leavenworth, Kan., not to be Lighted —In a sudden freak of what is called economy, the city of Leavenworth, Kan., has decided not to light the street lamps —*Ibid.*

Reducing the Price of Gas.—A leading gaslight company of New York has reduced the price of gas twenty-five cents The officials say the reduction is made on account of the growing use of kerosene.—*Ibid.*

Extraordinary Velocity of Gas.—They say the poorer the quality of illuminating gas, the greater velocity it will attain in rushing through the meter. This explains to the American people the amazing phenomenon they have sometimes witnessed, of the index figures on the meter dials making thirteen hundred revolutions a minute.—*Burlington Hawkeye September* 20.

Light in Jersey Citl.—Mayor Leider, of Jersey City, yesterday signed the contract for lighting a large section of the city with Fayette vapor gas lamps, at a trivial expense compared with that hitherto charged by the Jersey City Gas-Light Co. The new Police Commissioners have taken a firm stand for economy, in the matter of lighting the streets, and will save the city thousands of dollars.—*N. Y. Herald, Sep.* 21.

New Gas Works at Eau Claire, Wis.—Eau Claire, Wis., is to have gas works. The capital stock of the company constructing the same is $100,000, the officers being John Everitt, of Boston, President; A. E. Swift, Chicago, Vice President; and Geo. S. Redfield, Chicago, Secretary. The dimensions of fire proof buildings, work upon which will be commenced at once, the contract having been let, are 100 x 32, 90 x 32 and 60 x 60, and a cistern 55 feet in diameter and 17 feet deep. The pipe has been ordered and will commence to arrive within the next two weeks, when work upon the mains will begin. About five miles in all will be laid and it is the intention of the company to have the new works completed by November 1st. —*Eng. News.*

An Instalment of Dock Improvement.—In accordance with the ordinance passed by the Board of Alderman early in the summer, the Commissioner of Public Works, acting in connection with the Dock Department, is actively prosecuting the work of erecting gas lamps on the docks, for the purpose of lighting the docks and piers of the city. The ordinance contemplates supplying lamps on the North River side from the Battery to pier 34, and on the East River side to pier 37, and already five piers on the North River and four on the East River are lighted, much to the satisfaction of the residents in the vicinity. The improvement is a needed and useful one, and will, no doubt, be eventually extended to the whole line of docks on both rivers. It is fortunate, oo, that it is being made at a fair and reasonable expense. Five lamps complete, with the connection, cost only $115, and the charge for lighting will be less than $20 a lamp for the year. If the work had been done a few years ago, some persons would have made fortunes out of it. Now that we are enabled to secure necessary public improvementt without paying four or five hundred per cent. more than the work is worth the expenditure will not be begrudged.—*New York Herald, Sep.* 24.

[Through the courtesy of the Superintendent of Lamps and Gas, we are enabled to give the number of lamps erected on the piers, up to the present time, as follows:

North River Piers—Harrison street, 5 lamps; Franklin street, 5 lamps; West 10th street, 10 lamps; West 22nd street, 5 lamps; West 24th street, 5 lamps.

East River Piers—Pier 24, 5 lamps; Grand street, 3 lamps; Twenty-third street, 5 lamps; Thirty-third street, 3 lamps.

The Mutual Gas-Light Co., of Brooklyn.—The Mutual Gas-Light Company, of Brooklyn, N. Y., capital stock $3,000,000 (a new company), has contracted to supply private consumers at $2, and the city at $1.75 per 1000 cubic feet.—*Eng. News.*

Award of Contract.—The City Council of Hamilton, Ohio, have awarded the contract for furnishing that city with gas, for a period of ten years, from June 3rd, 1878, to the Citizens Gas-Light Company of Hamilton.—*Ibid.*

Great Britain.

Limiting the Price of Gas in London.—The price of gas in London, Eng., is limited by the law to $1.10 per thousand feet of 12-candle power, and constant and close supervision keeps the quality up to the standard.—*Ibid.*

Postponing the Purchase of Gas Works.—Quite recently the Exeter Town Council (England) decided to postpone the purchase of gas works, "on account of the success of the electric light, and the probability of its superseding gas."—*Ibid.*

The Electric Candle.—We are not certain that the "electric candle" has not rendered an essential service to one Gas Company—the Liverpool United. By the report which we publish in another column, it will be seen that the proposal of the Special Gas Committee of the Corporation of Liverpool to open negotiations for the transfer of the Company's undertaking to the Corporation, has practically fallen through. The Committee have been authorized to have an interview with the Directors to ask on what terms they would sell, but have not been empowered to treat for the purchase There is no disguising the fact, that the Company are strongly represented in the Town Council; still, it will be seen that a good deal of use was made of the "electric candle" to frighten the Council from engaging in an enterprise which might presently be superseded. From two points of view, we regard the result with satisfaction. In the first place, we entirely deprecate the possession of purely commercial undertakings by Corporations; and then we regard the enormously increasing debts of Local Authorities with great apprehension. The Liverpool Company could never sell their undertaking for less than the price justified by past profits and a prospective increase. The purchase would land the Corporation in a debt, large even for Liverpool, and the eventual result could not be foreseen. It might be that the works, under Corporation management, would turn out a source of profit; it is quite as likely, as said by some members of the Council, that they would involve a loss. In any case there is the danger—distant, most undoubtedly, notwithstanding the announcement of M. Jablochkoff, that in three months he will have something startling to show—that gas may be superseded by some other illuminating agent. And what would the ratepayers of Liverpool then say? Altogether, we come to the conclusion that the Corporation are far better without the gas-works. The have their hands, as Alderman Samuelson very correctly said, sufficiently full already, and their endeavors should be directed rather towards compelling the Company to fulfil their accepted contracts than to the acquisition of the undertaking, which might prove disastrous.—*Journal of Gas Lighting.*

British Provinces.

St. John's (N. B.) Gas-Light Co.—It is anticipated that the St. John's (N. B.) Gas Company will be in a position to again supply gas to the city by the 1st of October next.—*Eng News.*

Chemical and Scientific Repertory.

Lighting a Building by Electricity.—The building now being erected for the *Herald*, in Boston, will be supplied with an electric lighting apparatus, so that it will be unnecessary to use a match anywhere on the premises. This will be the first building of this kind in this country in which the new principle has been applied.—*Engineering Newss*

A New Explosive.—A new explosive for large guns has been invented by Capt. Totten, U. S. A. It consists of a spherical nucleus of gun cotten surrounded by a casing of powder, raising the diameter of the whole charge to double that of the nucleus. This is said to prevent the waste of gunpowder blown out of the barrel while still burning, and also renders harmless the immense strain produced by the explosion of gun cotton.—*Ironmonger.*

Lavish and Profitable Publicity.—One of the best known houses in the manufacture of engines, pumps, and agricultural machinery in Paris, set apart and expend annually the sum of £6000 stering for advertisements, which, we are informed, bring satisfactory returns to them in the nourishment and development of their busidess.—*Ibid.*

The Paris Exposition of 1878.—Two thousand pounds sterling has been appropriated by the Commissioners of the Paris Exposition of 1878, in aid of artisans who have meritorious objects to exhibit, constructed by their own hands, and who are working for their own account, but are unable to defray the expense of exhibition from their own resources. The prefects of each of the eighty-six departments are to supervise the applications under this head.—*Ibid.*

An Icelandic Newspape..—A type foundry in St. Paul has lately furnished the types for the *Framvavian* Iceland newspaper, to be published in the Icelandic colony at Keewatin, on the Red River, in British territory, about sixty miles from Fort Garry. This will be the first newspaper published on the American continent in the Icelandic language. The preparation of the types required the greatest care. They are in the Roman alphabet, but with a great many peculiarities in regard to accentation, and are of a very antiquated form. The Icelandic language is something like the Norwegian language as it was spoken about 1000 years ago.—*N. Y World.*

Coal Discovery in Victoria.—Another coal discovery has been chronicled in Australia. This time the good news is from the Gippsland district in Victoria, and the locality within easy distance of the railway. The seam upon the surface is reported to be two-and-a-half feet thick, and the indications of the most promising character. At present Victoria is dependent upon New South Wales for its supply of coal; and the immense value the discovery of extensive coalfields in the colony would prove to Victoria may be judged of by the fact that the collieries of New South Wales export from the port of Newcastle alone over 20,000 tons a week, making a yearly total of above 10,000,000 tons.—*British Trade Journal.*

Coal Exports from Germany.—Germany is about to try the experiment of exporting coal on a large scale, and an association formed with this object, called the "Westphalian Coal Export Association," begins its operations. Coal-owners representing an output of 3,750,000 tons have, it is stated, a ready been enrolled, and an additional number of members is expected, sufficient to bring the total output represented to 6,000,000 tons. Special arrangements with several of the railway companies for the transit of coal to the North Sea ports have (says the *Manchester Guardian*) now for some time past been in operation, and in the ports both of the North Sea and the Baltic manifold relations have been opened with Chambers of Commerce, mercantile firms, and wharf-owners, with a view to promoting the consumption and export of German coal in the joint interest of those concerned. Cargoes have already been despatched to St. Petersburg, Riga, and other places, and additional contracts have been secured.—*Ibid.*

Report to the Secretary of State for the Home Department on the Subject of the Testing of Petroleum.

By Dr. F. A. Abel, F. R. S.,
Chemist to the War Department.

The opinion has become very general that the so-called open "flashing-test," as required by the existing Petroleum Act, is unsatisfactory and even fallacious. The chief objection is that it is liable to "manipulation," accidental or designed, *i. e.*, "in consequence of certain very readily variable elements in the details of the test (added to the interfering action of even slight currents of air) the flashing-point of one and the same sample may be made to differ many degrees in the hands of different operators, or of one and the same operator at different times. On this point Messrs. T. W. Keates, Dugald Campbell, the late Dr. Letheby, Drs. Attfield, and B. H. Paul, Dr. Redwood, Secretary of the Petroleum Association, the Secretary of the Scottish Mineral Oil Association, and the local authorities under the Act at Bristol and Liverpool are substantially agreed. It is pointed out that "great difficulties have arisen in connection with the present regulations repecting the testing of petroleum oils, consequent upon the legalised acceptance of oils as safe or their condemnation as dangerous upon a difference of even *one* degree in their flashing-points as determined by a test which may give difference of *several* degress *with one and the same oil* in the hands of different operators." Prof. Abel has therefore elaborated a so-called "close-test" to be performed with a simple piece of apparatus, which is here described at length and figured, and which has been pronounced satisfactory by Messrs. Keates and Redwood, and also by the Secretary of the Scottish Mineral Oil Association, Mr. B. Calderwood. Prof. Abel's instructions for the application of the test are as follows:—The apparatus should be placed for use in a position where it is not exposed to currents of air.

The heating vessel or water-bath is filled by pouring water into its funnel until it begins to flow out at the spout of the vessel. The temperature of the water at the commencement of the test is to be 130°F.. and this is attained in the first instance either by mixing hot and cold water in the bath, or in a vessel from which the bath is filled until the thermometer provided for testing the temperature of the water gives the proper indication; or by heating the water with the spirit-lamp (attached to the stand of the apparatus) until the required temperature is indicated When a test is completed the water-bath is again raised to 130° by placing the lamp underneath, and the result is readily obtained whilst the petroleum cup is being emptied, cooled, and re-filled with a fresh sample to be tested. The lamp is then turned on its swivel from under the apparatus, and the next test is proceeded with. The test lamp is prepared for use by fitting it with a piece of flat plaited candle wick (*e.g.*, Field's night-light candle wick), and filling it with colza or rape oil up to the lower edge of the opening of the spout or wick-tube. The lamp is trimmed so that when lighted it gives a flame of about 0·15 inch in diameter, and this size is easily maintained by manipulation from time to time with a small wire trimmer. A test-flame arrangement for gas has been devised and may be substituted for the lamp The bath having been raised to the proper temperature the oil to be tested is introduced into the petroleum cup, being poured in slowly until the level of the liquid just reaches the point of the guage fixed in the cup. In warm weather the temperature of the room in which the samples to be tested have been kept should be observed in the first instance, and if it exceeds 65° the samples to be tested should be cooled down to about 60° by immersing the bottles containing them into cold water The lid of the cup, with the slide closed is then put on and the cup placed in the bath or heating vessel. The thermometer in the lid of the cup has been adjusted so as to have its bulb just immersed in the liquid, and its position is not under any circumstances to be altered. When the cup has been placed in the proper position the scale of the thermometer faces the operater. The test-lamp is then placed in position upon the lid of the cup, the lead-line or pendelum which has been fixed in a convenient position in front of the operator, is set in motion, and the rise of the thermometer in the petroleum cup is watched. When the temperature has reached about 66° the operation of testing is to be commenced, the test-flame being applied once for every rise of one degree, in the following manner;—The slide is slowly drawn open while the penduleum performs three oscillations, and is closed during the fourth oscillation.

After careful consideration we have every reason to believe that Professor Abel's method will lead to accurate results—no small boon to the general public as well as to all connected with the petroleum trade.—*Chemical News*

The New Bridges at Rotterdam.

Dutch engineering skill and enterprise have just completed an undertaking of a magnitude second to none of the many great works achieved by the Dutch before. It is well known that for centuries the Dutch people have waged constant war against the encroachments of the sea and the rivers by which their country is intersected. The hydraulic works are the first in the world; their bridges at Kutphen Kuylenburg, Bommel, and Maesdijk rival those of America. A fifth, the new railway bridge which crosses the Maas at Rotterdam, has just been added, which was formally opened on April 29th, and the importance of which for Holland need hardly be pointed out.

The work, after an expenditure of nearly 2,000,000 florins (£160,000), of which rather more than half has been expended on the superstructure, and less than half for the substructure, has been completed within eight years, about the same time required for the construction of the similar bridge at Hamburg, and that between Venice and the Continent. Five gigantic wrought-iron arched girders, resting on gigantic piers, and of spans ranging from 216 feet 6 in. to 295 feet 4 in., and a height of nearly 20 feet above ordinary high water level, connect the city with an island in the middle of the stream, two other arches uniting this island with the opposite shore.

Another great work at Rotterdam is now in course of completion, which has attracted general attention on the Continent. A few paces below the railway bridge, another bridge, the so-called "Willemsbrug," to serve for the ordinary carriage traffic of the city and foot passengers, is in course of construction. The foundation stone of this bridge was laid three years ago by the King of Holland in person. This, like the railway bridge, is provided with two pivot arrangements, of which one is within the city, the other in the canal called the King's Harbor (Koning's Haven), 656 feet wide, between the opposite shore and the island above mentioned, to permit the passage of the largest ships.—*Builder.*

Prices of Gas Coals.

Our quotations of gas coals remain without change:

Westmoreland	$5.50	$4.50	at Baltimore.
Penn	5.50	4.50	
Despard	5.35		
Marion	5.35		
Murphy Run	5.35		
Newburgh Orrel	5.35		
Ches. and Ohio RR. Caking Coal	5.25		
Block House	4.50	1.75	Gold f. o. b. at Mines
Glace Bay	4.25	1.60	
International	4.25	1.60	
Clover Hill	4.00		
Cannelton Cannel	10 00		
Peytona	10.00		

The receipts of domestic coa are increasing as the season advances, consumers evincing a desire to get their supplies for the winter in store, while navigation is favorable.

Foreign continues to arrive. Some new contracts for Newcastle for the New England market are reported.

Provincial is still enquired for, the receipts being absorbed as fast as they arrive. No material change in prices is looked for during the present season.

Gas Stocks.

Quotations by W. B. Scott & Co., Bankers,

24 Pine Street, New York City.

October 2, 1877.

☞ All communications will receive particular attention

	Capital.	*Par.*	*Bid.*	*Asked.*
Gas. Co.'s of N. Y. City.				
Central, Westchester	466,000	50	90	95
Harlem	$1,850,000	50	95	97
Manhattan	4,000,000	50	195	200
Metropolitan	2,500,000	100	127	131
" Scrip	$1,000,000	..	100	103
" Bonds	500,000	1000	92	94
Mutual	5,000,000	100	95	97
" Bonds, gold.	900,000	1000	105	—
Municipal	1,000,000	100	70	80
New York	4,000,000	100	128	131
Suburban, W'steh'str	390,000	50	—	100
Gas Co.'s of Brooklyn.				
Brooklyn	2,000,000	25	—	170
Citizens	1,200,000	20	70	75
" Scrip	320,000	1000	95	97½
Peoples	1,000,000	10	40	40
" Bonds	$ 325,000	...	—	95
" Scrip	300,000	...	75	80
Metropolitan	1,000,000	100	65	70
Nassau	1,000,000	25	80	85
" Ctfs.	700,000	1000	96	98
Williamsburgh	1,000,000	50	115	120
" Scrip		...	100	103
Union Co. E N. Y.		25	—	50
Out of Town Gas Companies.				
Bath, Maine	70,000	100		
Buffalo Mutual, N. Y	750,000	100	65	70
" Bonds	200,000	1000	95	100
Baltimore, Md	2,000,000	100	134	134
" Ctfs., gold	1,000,000		106	110
Bayonne, N. J		100		90
Brockport, N. Y	25,000	100	...	80
Citizens, Newark	918,000	50	100	105
" " Bds.	124,000	—	—	--
Cincinnati G & C Co				190
Derby of Conn	160,000	100	60	80
East Boston, Mass.		25	132	—
Fort Wayne, Ind.		100	...	—
Hannibal, Mo	100,000	100	95	100
Hartford, Conn	700,000	25	184	186
Hempstead, L I	25,000	100	...	—
Jersey City	386,000	20	155	160
Jamaica, L. I.	25,000	100	...	—

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Lima, Ohi,o.....	60,000	100	—	...
Bonds	30,000		90	
Laclede, St Louis Mo.		100	100	110
Long Branch.....	1,200,000	20	40	50
Peoples, Jersey City		...	120	125
Peoples of Albany...	650,000	100	-	27
" Bonds	350,000	1000	--	-
Peoples of Baltimore		25	--	56
" Bonds....			106	---
Perth Amboy		25	—	95
Rochester, N. Y.....		100	50	60
Richmond Co., S. I.	300,000	...	—	95
Woonsocket, R. I....	150,000	100	100	...
Halifax N. S.....	400,000	40	148	150
Hamilton, Ontario. .	150,000	40	117½	
San Francisco Gas-Co., S. Fr'isco Cal.			111	112
St. Louis, Missouri..	600,000	50	73	75
Stillwater, Minn....	50,000	50	—	26
Saugerties, N. Y	15,000	100	95	100
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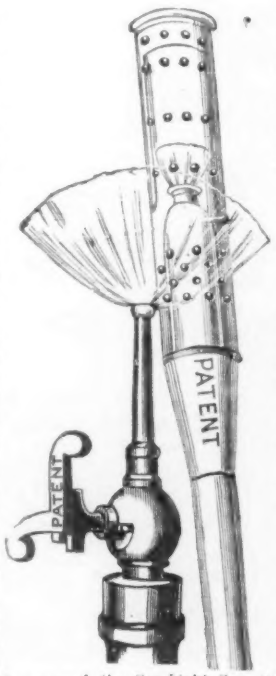

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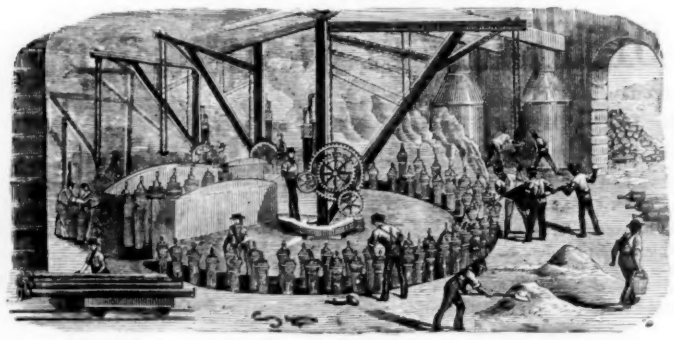

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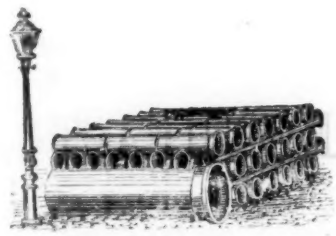

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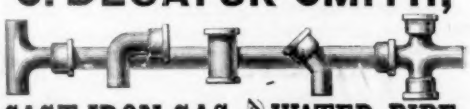

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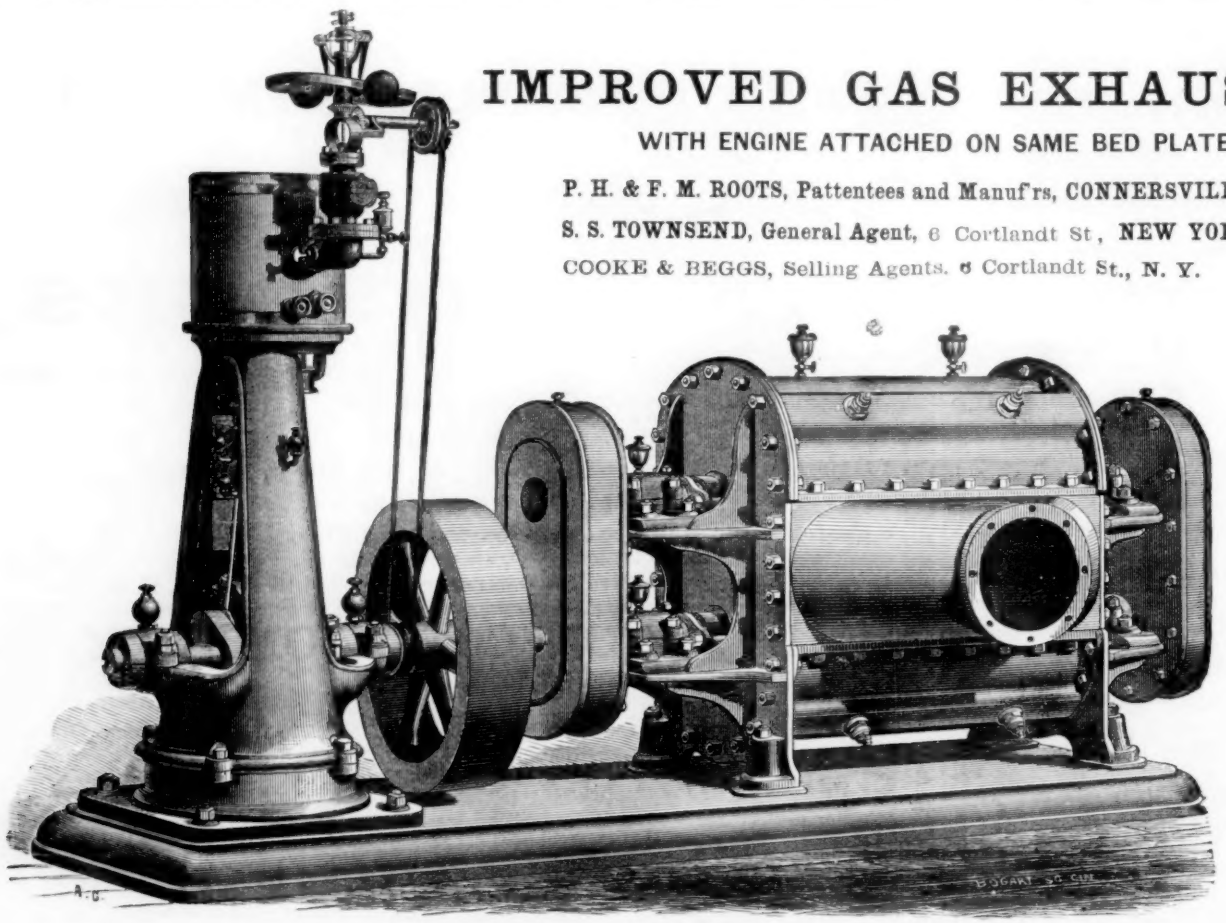

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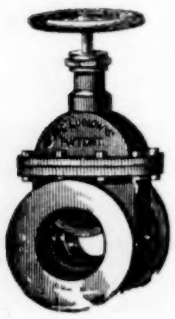

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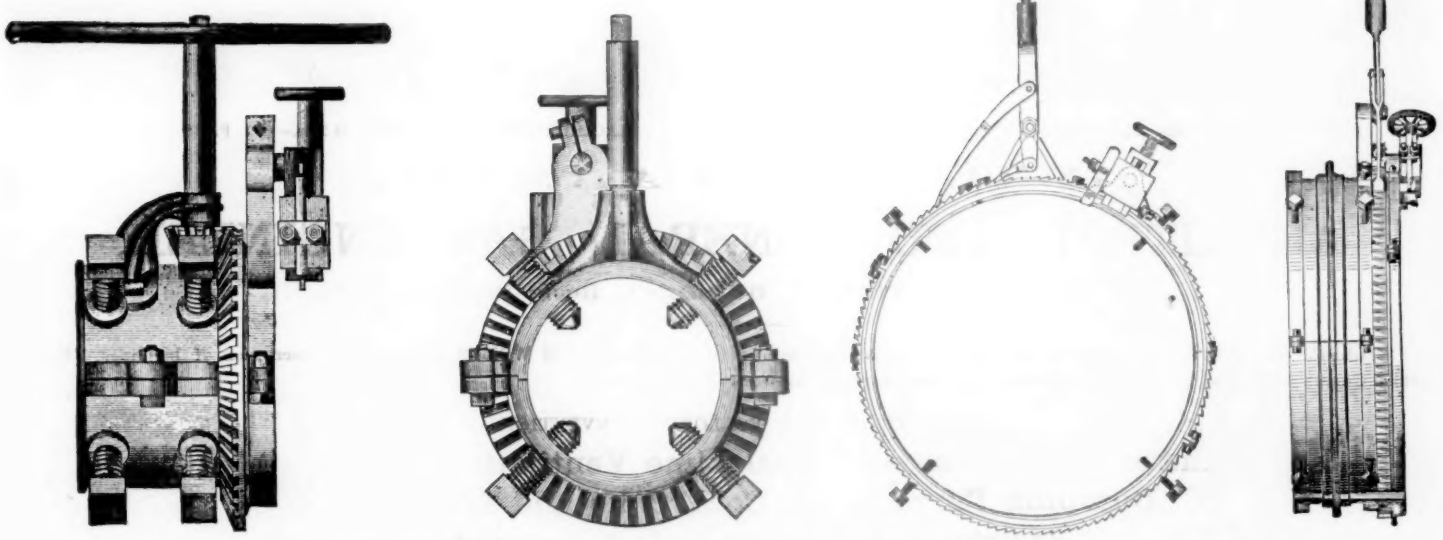

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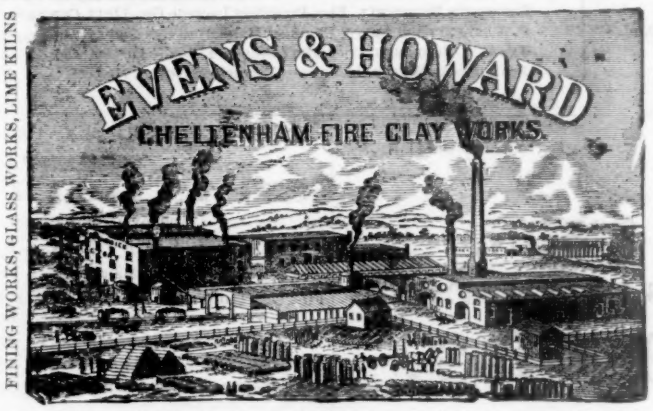

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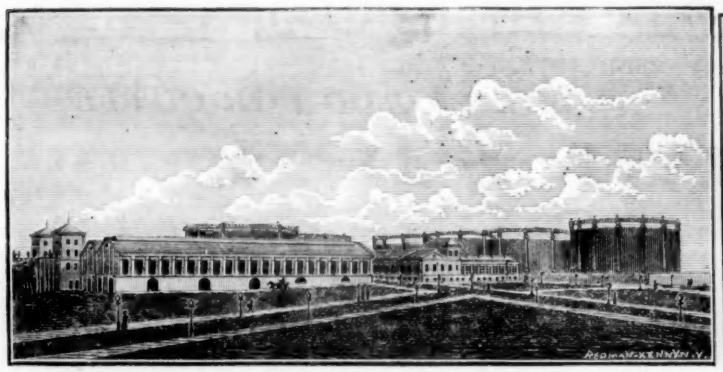

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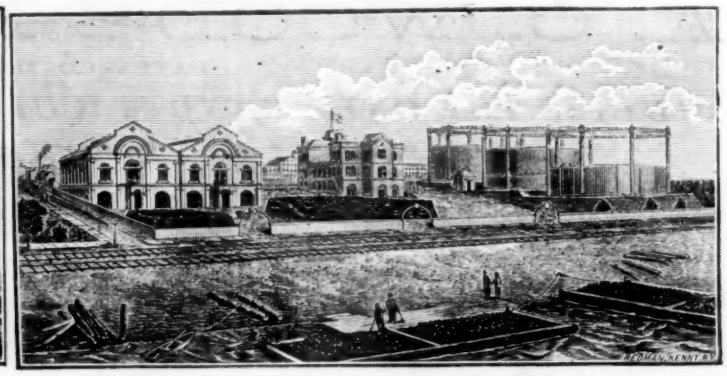

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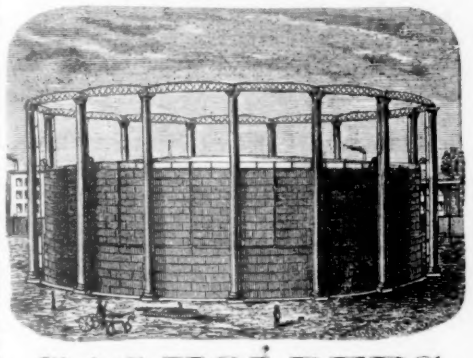

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INTERNATIONAL--1876--EXHIBITION.

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The Exhibit consists of a Series of METERS from the Largest Size Station Meters for the use of the MANUFACTURE OF GAS, to those for the use of the ORDINARY CONSUMER. The Instruments are WELL MADE, RELIABLE as to INDICATION, and embody a number of sundry improvements which, with the general character of the Exhibit, entitle the whole to commendation.

Attest—J. L. CAMPBELL, Secretary, pro-tem. Signed—A. T. GOSHORN, Director General J. R. HAWLEY, President

GROUP JUDGES.

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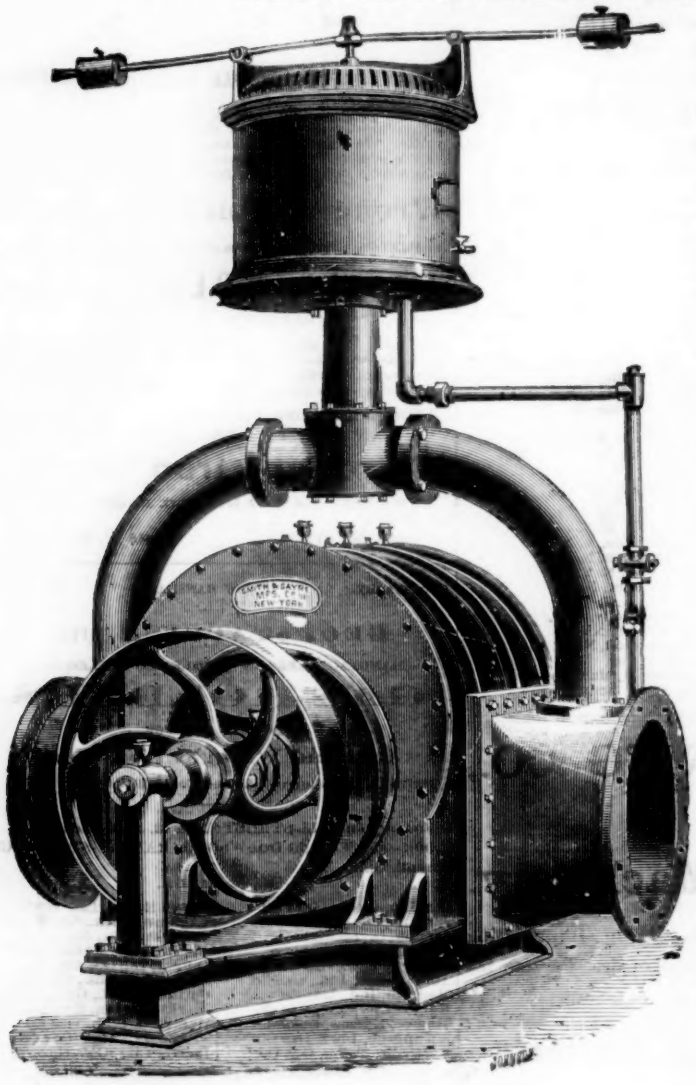
THE BEST AND MOST RELIABLE IN USE.



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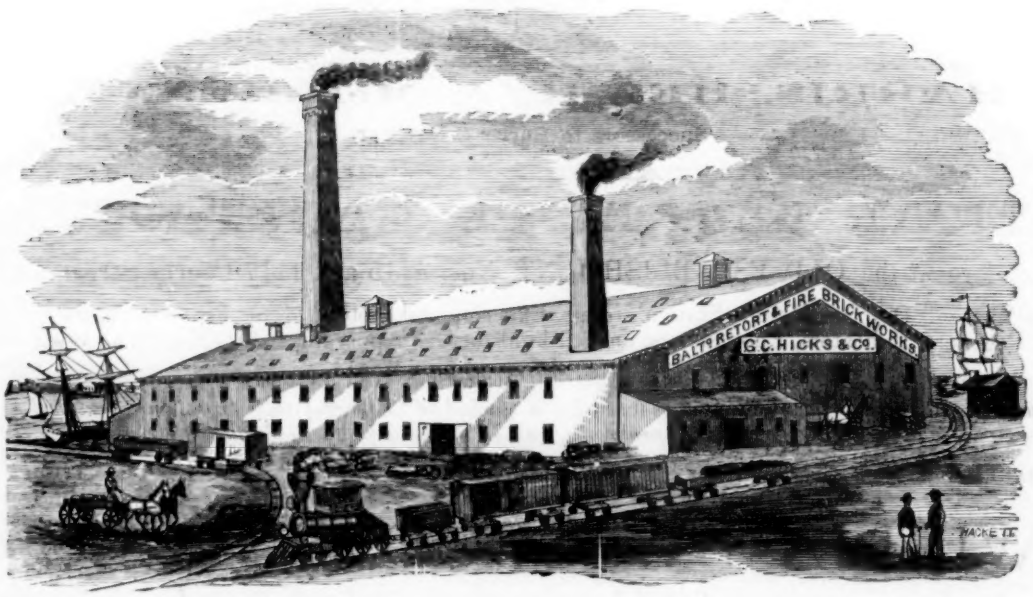

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Safe Delivery Guaranteed in any part of the Country.
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"GEO. C. HICKS, Esq.,

"Dear Sir,

"Among the letters which you placed in my hands for examination regarding the general standing of your fire clay, gas retorts, and gas furnace, bricks, &c., there were a number from the leading gas manufacturers of the U. S., speaking in the highest possible terms of their durability, freedom from the accumulation of condensed carbon, and general excellence. I regret that these letters are mislaid, or still remain in the Judges' room at the Centennial. I suppose you are aware that your retorts were awarded a First Premium at the Centennial.

"Yours truly, E. T. COX," *of the Centennial Jury of Awards*